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HETEROSIS AND COMBINING ABILITY IN YELLOW MAIZE (*Zea mays* L.)

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ABSTRACT

Fifteen new yellow inbred lines of maize were top crossed to three promising line testers, i.e. Gm. 1002, Gm.1004 and Gm. 1021 at Gemmeiza in 2004 season. The 45 top crosses plus three checks were evaluated at Gemmeiza and Mallawy Agricultural Research Stations in 2005 season. Significant differences were noticed between the two locations for all the studied traits, except resistance to late wilt disease. Mean squares due to crosses and their partitioning lines and testers were highly significant, while, lines x testers interaction were significant for grain yield, resistance to late wilt disease under two locations and their combined, while, it was significant for combined of days to 50% silking. The additive type of gene action was more important from non-additive type of gene action in the inheritance of all studied traits. The inbred lines Gm. 10, Gm. 14 and Gm. 22 exhibited positively and significant GCA effects for grain yield. Inbred lines Gm. 26, Gm.29 and Gm. 31 gave negative and desirable GCA effects for days to 50% Silking towards (ear liness), Gm. 30 for plant height towards (shortness), Gm. 16 for ear height towards (low ear position) and the inbred lines Gm. 13 and Gm. 14 gave highly significant and desirable GCA effects for resistance to late wilt disease. The line tester 1002 gave significant and desirable GCA effect towards earliness, short plants and resistance to late wilt disease, while, the line tester Gm. 1021 gave positive and highly significant GCA effects for grain yield. At least, seventeen crosses surpassed from the three checks (S.C. 155, S.C. 3080 and S.C 3084) in yield potentiality ,while, The highest mean performance were detected in the cross Gm. 17 x Gm.1021 (36.26 ard /fed) followed by the cross Gm.31 x Gm.1004 (34.91 ard ./fed) and the cross Gm 23 x Gm 1021 (33.99 ard /fed) , respectively. These crosses are favorable and could be used in maize breeding programs.

Keywords : *Maize, Zea mays L., Line x tester, Combining ability, Gene action, Heterosis , Top crosses* .

INTRODUCTION

Top crosses test provides information about the components of genetic variations and it helps the researcher in choice the best parents to produce good crosses in early and late generations and chair in crossing programs. Davis (1927) was the first to suggest the use of inbred lines x variety cross or top cross a method for evaluation maize inbred lines. Kempthorne (1957) detected a method of statistical analysis of the line x tester for testing general and specific combining ability of inbred lines and top crosses. Nawar and EL-Hosary (1984). They found that broad genetic base testers were more efficient than the marrow genetic base tester for evaluation of general combining ability in inbred lines of maize. EL-Zeir *et al* (2000) evaluated 17 inbred lines of maize using two testers. They found that the variance of lines, testers, L x T and their interaction with locations were highly significant, while, L x T x Loc. was not significant for grain yield. Also, Mahmoud (1996), Soliman and Sadek (1999) and EL-Shenawy *et. al.* (2003) and Ibrahim (2004) found that the additive genetic variance was more importance,while, Lonnquist and Gardener (1961) and Amer (2004). found thatthe non- additive genetic variance was more importance from additive genetic variance. EL-Zeir *et al.*, (2000) and Amer *et al.*, (2003). Therefor, the present investigation aims to study the relative importance of general and specific combining ability and their interaction with different lactations, determine the magnitude of heterosis in their top crosses for grain yield and identify superior inbred lines and their top crosses to could be used it in hybrid maize breeding programs.

MATERIALS AND METHODS

Fifteen new yellow inbred lines, namely; Gm. 6, Gm. 10, Gm. 14, Gm. 16, Gm. 17 , Gm. 18, Gm. 22, Gm. 23, Gm. 25, Gm. 26, Gm. 27, Gm. 29, Gm. 30, Gm. 31and Gm. 32 were used in this investegation. These inbred lines were developed at Gemmeiza Agricultural Research Station. The inbred lines 1002, 1004 and 1021 have the narrowest genetic base were used as testers to give 45 top crosses during the summer season of 2004. The forty five top crosses and three checks (S.C. 155, S.C. 3080 and S.C. 3084) were evaluated under two different locations (Gemmeiza and Mallawy Agricultural Stations) in summer season of 2005. A Randomized Complete Block Design (RCBD) was used with four replications for the two locations. The plot size was one row 6 m long and 80 cm a part with 25 cm between hills. The different agronomic operations were carried out during summer season of 2005. The data were collected on : Days to 50% silking , plant height (cm), ear height (cm), ear position (%), resistance to late wilt disease (%) , ear length (cm), ear diameter (cm), number of rows /ear, number of kernels/ row, grain yield (ard./fed.) adjusted to 15.5% grain moisture content.

The analysis of variance of Randomized Complete Block Design for each location and across the two locations was used to according to Steel and Torrie (1980).

Combining ability analysis was computed using the line x tester procedure suggested by Kempthorne (1957). Combined analysis between the two locations was done based on the homogenety test.

RESULTS AND DISCUSSION

The analysis of variance for separate location (Gemmeiza and Mallawy) and their combined involved forty five top crosses resulting from (15 inbred lines x 3 testers) are presented in table 1. Locations mean squares for all studied traits were significant except resistance to late wilt disease. This result would indicate that the genotypes (crosses) were affected by location to another and agreed with what obtained by EL-Zier (1999), Amer *et. al.*, (2002) and Ibrahim (2004).

Mean squares due to crosses (C) and their two partitioning : Lines (L) and testers (T) were highly significant for all traits under the two locations (Gemmeiza and Mallawy) and their combined, mean squares due to linesx testers (L x T) were significant for grain yield, resistance to late wilt but not significant for plant height , ear height and days to 50% silking , except, the combined of days to 50% silking was significant in the same order.

Table 1. Mean squares for grain yield and some of other traits at Gemmeiza, Mallawy and their combined data in 2005 season.

S.O.V	D.F	Days to 50% silking			Plant height			Ear height			Resistance to late wilt %			Grain yield		
		Gem.	Mall.	Comb.	Gem.	Mall.	Comb.	Gem.	Mall.	Comb.	Gem.	Mall.	Comb.	Gem.	Mall.	Comb.
Locations (Loc.)	1	--	--	5017.60**	--	--	32167.80**	--	--	272.40**	--	--	4.72	--	--	36.76*
Rep / Loc.	6	--	--	20.11	--	--	1007.21	--	--	13.85	--	--	195.83	--	--	13.39
Crosses(C)	44	8.92**	7.41**	14.64 **	348.20**	481.24 **	691.47 **	7.12**	18.19**	17.40 **	124.47	75.22**	170.75**	129.23**	139.75**	242.18**
Lines (L)	14	3.77*	3.39*	5.16**	368.09**	635.24**	844.09**	6.03*	16.76*	13.87**	87.99**	96.13**	150.93**	87.23**	127.22**	184.13**
Testers (T)	2	134.22**	108.62**	238.33**	3180.91**	4681.87**	7362.69**	68.51**	196.38**	196.62**	1573.11**	499.64**	1912.10**	1275.65**	1468.54**	2658.62**
L x T	28	2.54	2.19	3.40*	135.92	104.20	138.64	3.36	6.18	6.36	39.24*	34.44*	56.27**	68.34**	51.10**	98.75**
C x Loc.	44	--	--	1.69	--	--	137.97	--	--	7.91*	--	--	28.94	--	--	26.8**
L x Loc.	14	--	--	2.00	--	--	159.24	--	--	8.92**	--	--	33.19*	--	--	30.32**
T x Loc.	2	--	--	4.51**	--	--	500.09**	--	--	68.27**	--	--	160.65**	--	--	87.57**
L x T x Loc	28	--	--	1.33	--	--	101.48	--	--	3.18	--	--	17.41	--	--	20.69
Error	2.64	1.81	0.87	1.34	84.04	95.24	89.64	2.56	4.62	3.59	17.95	14.13	19.04	7.03	10.49	8.76
C.V.%	--	2.48	1.50	1.99	3.68	4.25	3.95	1.13	1.73	1.43	4.35	3.83	4.46	9.75	12.10	11.05

*,** Significant and highly significant at 0.05 and 0.01 level of probability

Table 2. Average performance of 45 top crosses of grain yield and some of other traits at Gemmeiza (Gem), Mallawy (Mall) and their combined data in 2005 season.

Top Crosses	Days to 50% silking (day)			Plant height (cm)			Ear height (cm)			Resistance to late wilt(%)			Grain yield (ard/fed)		
	Gem.	Mall.	Comb.	Gem.	Mall.	Comb.	Gem.	Mall.	Comb.	Gem.	Mall.	Comb.	Gem.	Mall.	Comb.
Gm 6x 1002	54 00	60.75	57 37	256.00	224 25	240 12	141 25	117 75	129.50	100.00	100.00	100 00	23 64	26 55	25 09
Gm 6x 1004	57 00	63.75	60 37	236.75	224 75	230.57	140 25	118.25	129.25	89 75	94 25	92 00	17 88	17 44	17 66
Gm 6x 1021	55 50	62 75	59 12	259 75	244.50	252.21	146.25	131 50	138.87	92 75	98 75	95 75	18 98	27 60	23 28
Gm 10x 1002	53.25	61 00	57.12	235.25	220.25	227.75	131.00	116.00	123.50	99 75	99 75	99 75	27 6	27 20	27 40
Gm 10 x 1004	58.00	64 50	61.25	237 00	221.75	229 37	136 25	116 75	126.50	97 75	98 25	98.00	19 08	18.03	18.55
Gm 10 x 1021	53 25	62.25	57 75	252.75	231.25	242 00	146.50	129 75	138 12	98.00	100.00	99 00	32 29	34 99	33 64
Gm 14 x 1002	53 75	60 50	57 12	254.00	218 50	231.75	134 25	114.00	124 12	100.00	99 00	99 50	30 20	31 28	30 74
Gm 14 x 1004	57 75	64.50	61 12	237 25	231.00	234 12	141.75	123.50	132.62	90.25	94 00	92 12	14 41	16 25	15 33
Gm 14 x 1021	54.25	61 25	57.75	252 75	239.00	245 67	147.50	134.00	140.75	96 75	95 25	96 00	24 52	27 83	26 17
Gm 16 x 1002	53 00	59.00	56.00	250.50	227.25	238.37	128.50	119.00	123 75	100.00	97.75	98.87	29 38	26 73	28 6
Gm 16 x 1004	55 00	62.75	58 87	240.75	233 75	237.25	137.75	129.25	133 75	97.00	98.25	97 62	23 66	24 79	24.32
Gm 16 x 1021	53 00	59 75	56.37	259.25	234.05	246 65	149.25	130.25	139 75	96.00	97.25	96.62	30 24	27 55	28 90
Gm 17 x 1002	53.75	61.00	57.37	242.75	223 00	232.87	134 25	120.75	127.50	99.25	98.25	98 75	26 97	27.12	27 05
Gm 17 x 1004	57.00	63 50	60.25	231.50	228 75	230 12	141.25	122.75	132.00	96 25	97 25	96 75	19 21	24 60	21.90
Gm 17 x 1021	54.00	62.00	58.00	253.25	248 50	250.87	150.50	140 25	145.37	99 25	97 50	98 37	31 75	40 72	36 26
Gm 18 x 1002	53 75	62.00	57.87	230 75	220.25	225.50	131.75	115.75	123.75	99 50	99 25	99 37	22.34	24 44	23.93
Gm 18 x 1004	56 50	63.50	60.00	221.75	214.25	218.00	133.50	112 75	123 12	92 75	94.75	93 75	15 03	18 18	16 60
Gm 18 x 1021	52 75	61.25	57 00	245.00	230 25	237 62	142 00	126.50	134.25	96.00	96.50	96.25	23 76	22.68	23 22
Gm 22 x 1002	53.00	60 75	56.87	243 75	217 75	230 75	129 25	113.25	121 25	100.00	98.25	99 12	31 14	36 67	33 91
Gm 22 x 1004	55 25	63 50	59.38	237.50	229.00	233.25	134 75	124.00	129.37	93.00	96 00	94 50	19 00	23.50	21 25
Gm 22 x 1021	53 75	60.50	57.12	256.50	231.00	243.75	149.25	127 25	136.25	96.50	98.00	97 25	24 26	25 79	25.02
Gm 23 x 1002	53.50	61 00	57.25	245.00	220.00	232.50	134.00	114.50	124.25	100.00	99 75	99 87	32 95	27 73	30.34
Gm 23 x 1004	55 50	63.00	59.25	248.25	222.75	235.50	136.25	117 50	126.87	93 25	95.25	94.25	18 91	20 12	19 55
Gm 23 x 1021	53.50	60.50	57 00	252.00	229 25	240.62	145 50	124.00	134 75	94.75	94 75	94 75	29 08	38 99	33 99
Gm 25 x 1002	54.00	59.25	56 62	250.25	224 50	237.37	133 25	119.50	126.37	100.00	99 50	99 75	32 92	27 61	30 26
Gm 25 x 1004	56.75	63 75	60.25	231.75	214.00	222.87	127 00	112.25	119.62	94 75	98.00	96 37	18 32	22.613	20 46
Gm 25 x 1021	54 00	61.50	57 75	254.50	235.25	244 87	147.00	129.50	138 25	99.00	99 00	99 00	32 98	31 28	32 13
Gm 26 x 1002	54 50	62.00	58.25	258.50	[illegible]	246.50	140.50	127.25	133 87	100.00	100 00	100 00	31 63	27 74	30.68
Gm 26 x 1004	55 00	63.25	59.12	252.00	231 25	241 62	143.25	123 25	133.25	97 25	99 00	98 12	22 98	22 30	22 64
Gm 26 x 1021	54.50	61.75	58 12	263.75	257.50	260.62	150.00	133.00	141.50	96 25	98 25	97 25	32 24	33 50	32 87
Gm 27 x 1002	54.00	61.25	57.62	242.00	225.75	233 87	130.25	119.00	124.62	100.00	100 00	100.00	32 57	28 18	30 74
Gm 27 x 1004	56.00	63.25	59.62	237.00	231.75	234.37	139.50	124 75	132.15	97.05	97 75	97 62	22 59	23.39	22.99
Gm 27 x 1021	54 50	61.50	58.00	271.00	237.50	254.25	152.57	131.25	142.00	96 75	93 00	97 37	32 54	31 96	32 25
Gm 29 x 1002	53 00	69.00	56.00	259.75	230.25	245.00	142.75	122 75	132 75	99 75	97 75	98 75	32 64	33.42	32 94
Gm. 29 x 1004	56 25	64.00	60.12	246.25	222.50	234.37	141.50	117.75	129 62	99.50	97 25	98 37	23 66	21 35	22 50
Gm 29 x 1021	53 75	61 75	57.75	268.25	234.50	251.37	148 25	129.75	139.00	99 75	99.75	99 75	34 53	27 42	30.98
Gm 30 x 1002	53.50	61 25	57.37	259.50	243.50	251.50	142.50	131.00	136 75	100.00	100.00	100.00	31.13	23.85	27 49
Gm 30 x 1004	55.75	64.75	60.25	248.00	221.50	234.75	141.75	123 75	132.75	99.25	100.00	99 62	20 43	21 45	20 94
Gm 30 x 1021	53.00	61.75	57.37	259.75	250.75	255.25	144.00	139 50	141.75	100.00	99.50	99 75	32 50	29.37	31 18
Gm 31 x 1002	54.00	60.25	57.12	257 50	229.50	243.50	142.25	123.75	133.00	99.50	100.00	99.75	24 68	26 42	25 55
Gm. 31 x 1004	54 25	63.50	58.87	255.50	232.50	244.00	148.25	126.25	137.25	97.00	100 00	98 50	35 01	34 81	34 91
Gm 31 x 1021	54 00	63.75	58.87	265.50	238.50	252 00	157 50	136.25	146.87	98 50	99 75	99 62	33 10	31 00	32.05
Gm. 32 x 1002	53 50	61.50	57.50	252.25	226.25	239.25	143.00	125.00	134.00	100.00	98.25	99 12	29 96	23.80	26 88
Gm 32 x 1004	54 75	62 75	58.75	236.50	221.25	228.87	141.50	116.75	129 12	94.00	94.50	94.25	19 71	21.37	20 54
Gm. 32 x 1021	53.50	61.50	57.50	248 75	230.00	239.37	148.00	127 00	137.50	97 75	98.25	98.00	25.53	27.19	26 36
$\overline{X}$	54 30	62.19	58.24	248.85	229.73	239.29	141.05	123.97	132.51	97.48	98.08	97.76	27.19	26.77	26.78
Check SC 155	54 25	63.00	58.62	261.50	237 50	249.50	145.50	130.25	137.87	100.00	100.00	100 00	29 87	27 40	28 64
SC 3080	55.00	62.00	58.50	257.00	243.75	250.37	132.25	128 75	130.50	100.00	100.00	100.00	28.68	27.74	28.20
SC 3084	58.75	65.00	61 88	259.50	261.00	260.25	146.75	147.75	147.25	97.75	96 50	97.12	25 37	33.33	29.35
L S D 0.05	1 32	0.91	1.13	8.98	9.56	9.28	1.57	2 11	1.86	4.15	3.68	4.28	3 00	3 17	2 90
L S D 0 01	1.74	1.20	1.49	11.83	12.59	12.21	2.06	2.77	2.44	5 47	4.85	5.63	3 42	4 18	3 62

On the other hand ,mean squares due to crosses x loc. were significant for grain yield and ear height only, while, mean squares due to their partitioning (Lines x loc.) were significant for grain yield ,resistance to late wilt and ear height , (Testers x loc.) were significant for all the studied traits , while, the interaction of lines x testers x locations (L x T x loc.) was not significant. These results showed that the genotypes varied significantly form location to another and agreed with what obtained by Amer *et.al.*, (2003).

Mean performance of 45 top crosses for grain yield at Gemmeiza, Mallawy locations and their combined data are shown in table 2. Values mean performance of grain yield ranged from 14.41 ard./fed. for the cross Gm.14 x Gm.1004 to (35.01 ard./fed.) for the cross Gm.31 x Gm.1004 ,while, 18 top crosses gave higher values from the highest commercial hybrid S.C.155 (29.87 ard /fed.) under Gemmeiza conditions. Values of mean performance for grain yield ranged from (16.25 ard./fed.) for the cross Gm.14 x Gm.1004 to (40.72 ard./fed.) for the cross Gm.17 x Gm.1021, while, 7 top crosses gave higher values from the highest commercial hybrid S.C. 3084 (33.33 ard /fed.) under Mallawy conditions. Moreover, values of mean performance for grain yield from (15.33 ard /fed.)for the cross Gm.14 x Gm.1004 to (36.26 ard /fed.) for the cross Gm.17 x Gm.1021 ,while, 17 top crosses surpassed from the over mean (29.35 ard /fed.) for combined data of (Gemmeiza and Mallawy) locations. Therefor, it could be considered these top crosses are fruitful, promising, due to the highest yield potentiality and gave desirable values for earliness, short plants and resistance to late wilt disease. These results indicated that these top crosses could be recommended as promising crosses and utilize it in maize hybrid breeding programs. Estimates of variance for general $(\delta^2 GCA)$ and specific $(\delta^2 SCA)$ combining ability and their interaction with locations are given in table 3. The results showed that $(\delta^2 GCA)$ was higher than $(\delta^2 SCA)$ for all the studied traits. This indicated that the additive gene action was more importance in inheritance of all studied traits.

Table 3. Estimates of variance of general $(\delta^2 GCA)$ and specific $(\delta^2 SCA)$ combining ability and their interaction with two locations (Gemmeiza and Mallawy).

Variance	Days to 50% silking	Plant height	Ear height	resistance to late wilt %	Grain yield
$\delta^2 GCA$	1.625	51.647	0.895	12.441	18.351
$\delta^2 SCA$	0.175	-2.576	-0.391	2.886	8.663
$\delta^2 GCA / \delta^2 SCA$	9.286	-20.049	-2.806	4.311	2.118
$\delta^2 GCA$ x Loc.	0.045	3.420	0.957	2.206	1.063
$\delta^2 SCA$ x Loc.	-0.005	2.961	-0.029	0.343	2.892
$\delta^2 GCA$ x Loc. / $\delta^2 SCA$ x Loc.	-9.000	1.155	-33.000	6.437	0.368

These results are agreement with what was obtained by Matiznger *et.al.*,(1959), EL-Zeir *et.al.*, (1993), Soliman and Sadek (1999), Ibrahim (2004) and Ibrahim and Osman (2005)for grain yield Amer *et. al.*,(2002)for silking date and plant height. On the other side, the$(\delta^2 GCA)$ x loc. interaction was higher Heterosis percentage relative to three checks (S.C. 155, S.C. 3080 and S.C. 3084) in Gemmieza, Mallawy and combined date are presented in table 4.

Table 4. Percentage of heterosis for 45 top crosses relative to three checks for grain yield in Gemmeiza, Mallawy and their combined data.

Crosses	Gemmeiza			Mallawy			Combined		
	S.C. 155	S.C. 3080	S.C. 3084	S.C. 155	S.C. 3080	S.C. 3084	S.C. 155	S.C. 3080	S.C. 3084
Gm. 6 x 1002	-20.86 **	17.57 **	-6.82 **	-3.10	-4.29	-20.34 **	-12.40 *	-11.03 *	-14.51 **
Gm. 6 x 1004	-40.14 **	-37.66 **	-29.25 **	36.35 **	37.13 **	47..67 **	-38.34 **	-37.38 **	-39.83 **
Gm. 6 x 1021	-36.46 **	-33.82 **	-25.19 **	0.73	-0.50	-17.19 **	-18.72 **	-17.45 **	-20.68**
Gm. 10 x 1002	-7.60	-3.77	-8.79	0.73	-1.95	-18.39 **	-4.33	-2.84	-6 64
Gm. 10 x 1004	-36.12 **	-33.47 **	-24.79 **	-34.20 **	-33.78 **	-45.90 **	-35.23 **	34.22 **	-36.80 **
Gm. 10 x 1021	8.10	12.59 **	27.28 **	27.70 **	26.14 **	4.98	17.46 **	19.29 **	14.62
Gm. 14 x 1002	-1.10	-5.30	-19.00 **	14.16 *	12.76 *	-6.15	7.33	9.00	4.74
Gm. 14 x 1004	-51.76 **	-47.76 **	-43.20 **	-40.69 **	41.42 **	-15.25 **	-46.47 **	-45.64 **	-47.77 **
Gm. 14 x 1021	-17.91 **	-14.50 **	-3.35	1.57	0.32	-16.50**	-8.26	-7.20	-10.83 *
Gm. 16 x 1002	-1.64	2.44	15.81 **	-2.45	-3.64	-19.80 **	-0.14	0.14	2.55
Gm. 16 x 1004	-20.12**	-16.81 **	-5.95	-9.53	-10.63	-25.62 **	-15.08 **	-13.76 **	-17.14 **
Gm. 16 x 1021	1.24	5.44	19.20 **	0.55	-0.68	-17.34 **	0.91	2.48	-1.53
Gm. 17 x 1002	-9.71 *	-5.96	6.31	-1.02	-2.24	-18.63 **	-5.55	-4.08	-7.48
Gm. 17 x 1004	-35.69 **	-33.02 **	-24.28 **	-10.22	-11.32	-26.19 **	-23.53 **	-22.34 **	-25.38 **
Gm. 17 x 1021	6.29	10.70 *	25.15 **	48.61 **	46.79 **	22.17 **	26.61 **	28.58 **	23.54 **
Gm. 18 x 1002	-25.21 **	22.11 **	-11.49 *	-10.08	-11.90 *	-26.67 **	-16.45 **	-15.14 **	-18.47 **
Gm. 18 x 1004	-49.68 **	-47.59 **	-40.76 **	-33.65 **	-34.46**	-45.45	-42.04 **	-41.13 **	-43.44 **
Gm. 18 x 1021	-20.46 **	-17.15 **	-6.35	-17.23 **	-18.24 **	-31.95	-18.92 **	-17.66 **	-20.69 **
Gm. 22 x 1002	4.25	8.58	22.74 **	33.83 **	32.19 **	10.02 *	18.40 **	20.25 **	15.54 **
Gm. 22 x 1004	-36.39	-33.75 **	-25.11 **	-14.23 *	-15.28 **	-29.93 **	-25.80 **	-24.65 **	-27.60
Gm. 22 x 1021	-18.78 **	-15.41 **	-4.38	-5.88	-7.03	-22.62 **	-12.64	-11.28	-14.75 **
Gm. 23 x 1002	10.31 *	14.89 **	29.88 **	1.20	-0.04	-16.80 **	5.94	7.59	3.37
Gm. 23 x 1004	-36.69 **	-34.07 **	-25.46 **	-25.57 **	-27.47 **	-39.63 **	-31.74 **	-30.53 **	33.39 **
Gm. 23 x 1021	-2.64	1.39	14.62 **	35.00	33.35 **	10.98 *	18.68 **	20.53 **	15.81 **
Gm. 25 x 1002	10.21 *	14.78 **	29.76 **	0.77	-0.05	-17.16	5.66	7.30	3.10
Gm. 25 x 1004	-38.67 **	-36.12 **	-27.79 **	-25.57 **	-18.50	-32.16 **	28.56 **	-27.45 **	-30.29
Gm. 25 x 1021	10.41 *	14.99 **	30.00 **	27.77**	12.76 *	-6.15	12.19 *	13.94 *	0.95
Gm. 26 x 1002	5.89	10.29 *	24.64 **	1.24	0.00	-16.77 **	7.12	8.79	4.53
Gm. 26 x 1004	-23.07 **	-19.87 **	-9.42 **	-18.31 **	-19.61 **	-33.09 **	-20.95 **	-19.72 **	-22.86 **
Gm. 26 x 1021	7.93	12..41 **	27.08 **	22.26 **	20.76 **	0.50	14.77 **	16.56 **	12.00 *
Gm. 27 x 1002	9.04 *	13.56 **	28.38 **	2.85	1.86	-15.45 **	6.98	9.00	4.74
Gm. 27 x 1004	-24.37 **	-21.23 **	-10.96 *	-14.64 *	-15.68 **	-29.82 **	-19.73 **	-18.48 **	-21.67 **
Gm. 27 x 1021	8.94 *	13.46 **	28.26 **	16.64 **	15.21 **	-0.04	12.60 *	14.36 **	9.88 **
Gm. 29 x 1002	9.27 *	13.81 **	28.66 **	21.97 **	20.48 **	0.27	15.01 **	16.81 **	12.23 **
Gm. 29 x 1004	-20.79 **	-17.50 **	-6.74	-22.21 **	-23.04 **	-35.94 **	-21.14 **	-20.21 **	-23.34 **
Gm. 29 x 1021	15.60 **	20.40 **	36.11 **	0.71	-1.15	-17.73 **	25.36 **	27.59 **	22.59 **
Gm. 30 x 1002	4.22	8.54	22.70 **	-12.96 *	-14.02 *	-28.44 **	-4.02	-2.25	-6.34
Gm. 30 x 1004	-31.60 **	-28.77 **	-19.47	-21.72 **	-22.67 **	-35.64 **	-26.89 **	-25.74 **	-28.65 **
Gm. 30 x 1021	-8.80 *	13.32 **	28.10 **	7.19	5.88	-11.88 **	8.87	10.57 *	6.24
Gm. 31 x 1002	-17.38 **	-13.95 **	-2.72	-3.58	-4.76	-20.73 **	-10.79	-9.40	-12.95 *
Gm. 31 x 1004	17.80 **	22.07 **	38.00 **	27.04 **	25.49 **	4.44	21.89 **	23.79 **	18.94 **
Gm. 31 x 1021	10.81 *	15.41 **	30.47 **	13.14 *	11.75 *	-6.99	11.91 *	13.65 **	9.20
Gm. 32 x 1002	0.30	4.46	18.09 **	-13.14 *	-14.20 *	-28.59 **	6.15	-4.68	8.42
Gm. 32 x 1004	-34.04 **	-31.28 **	-22.31 **	-22.01	-22.96 **	-35.88 **	28.28 **	27.16 **	30.02 **
Gm. 32 x 1021	-14.53 **	-10.98 *	0.63	-0.77	-1.98	-18.42 **	7.96	-5.52	10.19 *
L.S.D 0.05	2.60	2.60	2.60	3.17	3.17	3.17	2.90	2.90	2.90
L.S.D 0.01	3.42	3.12	3.42	4.18	4.18	4.18	3.82	3.82	3.82

Number of top crosses showed significant and highly significant positive heterotic effects for the three checks as follows :- 10 top crosses gave significantly heterotic effects relative to the commercial hybrid S.C. 155 and ranged from (-15.76% to 17.80%), 13 top crosses gave significantly heterotic effects relative to the commercial hybrid S.C.3080 and ranged from (-49.76% to 30.00%) and 20 top crosses gave significantly heterotic effects relative to the commercial hybrid S.C. 3084 and ranged from (-43.20 to 38.00) under Gemmeiza location. 11 top crosses exhibited significantly heterotic effects relative to S.C. 155 and ranged from (-36.35% to 48.61%), 12 top crosses exhibited significantly heterotic effected significantly heterotic effects relative to S.C.3084 and ranged from (-45.90% to 47.67%) under Mallawy location. While, 12 top crosses showed significantly heterotic effects relative to S.C. 155 and ranged from (-46.47 to 28.56), top crosses showed significantly heterotic effects relative to S.C. 3080 and ranged from (-45.064 to 28.58) and 10 top crosses showed significantly heterotic effects relative to S.C. 3080 and ranged from (-47.77% to 30.02%). the desirable heterotic effects relative to the three checks under Gemmeiza, Mallawy and their combined data ranged from (8.80 to 17.80 %, 10.29 to 22.07%, 14.62 to 38.00%, 13.14 to 48.61 %, 11.75 to 46.79%, 10.02 to 47.67%, 11.91 to 28.56%, 10.57 to 28.58% and 10.19 to 30.02%) ,respectively. The highest heterotic effects were detected in the cross (Gm. 32 x Gm.1004) followed by cross (Gm. 17 x Gm. 1021) and cross (Gm. 29 x Gm.1021). Number of Researchers reported high heterosis for yield of maize; i.e., EL-Rouby and Galal (1972), Mohamed (1984), Mahmoud *et al* (1990), Abdel-Sattar *et al.* (1999) Mosa (2003) and Ibrahim (2004).

General combining ability effects for fifteen inbred lines and three testers under Gemmeiza, Mallawy locations and their combined are presented in table 5. The inbred lines Gm. 29, Gm. 31 gave highly significant and desirable GCA effects for grain yield trait and could be used directly in hybrid breeding programs after testing for yield trails. The inbred line Gm.23 gave significant and desirable GCA effects for ear height towards (shortness). Also, the two inbred lines Gm. 13 and Gm. 14 had highly significant and desirable GCA effects for resistance to late wilt disease. On the other side, desirable GCA effects of the testers Gm. 1002 and Gm.1021 for days to 50% silking towards (ear lines), tester Gm. 1002 for plant height and ear height towards (shortness). The superiority of inbred lines as good testers were noticed by Mahmoud (1996) and Ibrahim and Osman (2005). While, the superiority of top crosses (varieties) were noticed by Amer et al (2002) and Ibrahim (2004).

Specific combining ability SCA effects of the 45 top crosses under Gemmeiza and Mallawy locations and their combined are given in table 6.The top crosses Gm. 10 x Gm. 1002, Gm. 14 x Gm. 1002 and Gm. 22 x Gm.1002 gave positive and highly significant SCA effects for grain yield trait under two locations and their combined.

Table 5. Estimates of general combining ability effects for grain yield and some of other traits at Gemmeiza, Mallawy and their combined data in 2005 season.

Genotypes		Days to 50% silking			Plant height			Ear height			Resistance to late wilt %			Grain yield		
		Gm.	Mall	Com.	Gm.	Mall	Com.	Gm.	Mall	Com.	Gm.	Mall	Com.	Gm.	Mall	Com.
Lines:-																
Gm.6		0.450	1.000**	0.725**	1.422	2.183	1.802	-0.962	0.135	-0.414	-4.964**	0.190	-2.387**	-3.164**	-6.218**	-4.691**
Gm.10		0.616*	0.333	0.475*	-5.327*	-6.993*	-6.157**	-0.126	0.303	0.089*	1.077	3.273**	2.175*	-0.077	-0.264	-0.171
Gm.14		0.117	0.750**	0.433	-0.244	-3.650	-1.947	-0.053	0.872	0.410*	-2.581*	-3.968**	-3.275**	-1.906*	-3.343**	-2.625**
Gm.16		-1.467**	-0.833**	-1.150**	2.088	1.516	1.802	0.560	-1.394*	-0.417	-0.814	-1.576	-1.195	-0.663	1.445	0.396
Gm.17		0.200	0.416	0.308	3.672	-6.150*	-1.239	0.864	1.835**	1.350**	1.568	-0.926	0.321	3.812**	-0.408	1.702*
Gm.18		0.283	-0.167	0.058	-8.161**	-16.150**	-12.155**	-0.543	1.676*	0.567	-2.747*	-2.960**	-2.854**	-5.265**	-6.005**	-5.635**
Gm.22		-0.383	-0.500	-0.441	-3.827	-2.733	-3.280	-0.222	-0.756	-0.489	-1.847	-2.010	-1.929*	1.627	-1.578	0.025
Gm.23		-0.467	-0.333	-0.400	-5.744*	-0.237	-2.990	-0.987	-1.020*	-1.004*	-2.514*	-2.368*	-1.257	1.277	0.571	0.924
Gm.25		-0.467	0.416	-0.025	-5.161	-3.150	-4.155*	-0.350	-1.510*	-0.930*	0.918	1.290	1.104	0.144	1.686	0.915
Gm.26		0.366	0.166	0.266	11.338**	9.433**	10.385**	-0.829	-0.756	-0.793*	0.043*	0.206	0.124	0.824	2.567*	1.696*
Gm.27		0.033	0.333	0.183	1.922	1.350	1.636	-0.001	-0.404	-0.203	0.802	1.273	1.038	0.818	2.850*	1.834*
Gm.29		-0.383	-0.166	0.274	-0.661	9.433**	4.386*	-0.113	-0.793	-0.453*	4.260**	-0.460	1.900*	3.709**	3.831**	3.770**
Gm.30		0.616*	-0.416	0.100	8.838**	7.300**	7.969**	1.124*	-0.931*	0.097	5.010**	4.981**	4.996**	-1.968*	1.634	-0.167
Gm.31		0.533	-0.416	0.058	3.755	10.850**	7.167**	1.186*	0.797	0.992*	2.202*	5.456**	3.834**	3.721**	4.549**	4.135**
Gm.32		-0.050	-0.583*	0.316	-3.911	-2.816	-3.363	0.456	1.947**	1.202**	-0.414	-2.401*	-1.408	-2.901**	-1.316	-2.109*
Testers:-																
Gm. 1002		-1.266**	-0.866**	-1.066**	-4.044**	-0.066	-2.055*	-0.783**	-2.078**	-1.431**	5.470**	2.848**	4.159**	0.933*	2.881**	1.907**
Gm. 1004		1.650**	1.550**	1.600**	-4.361**	-8.800**	-6.580**	-0.434	1.222**	0.394*	-4.677**	-2.921**	-3.799**	-5.006**	-5.712**	-5.359**
Gm. 1021		-0.383*	-0.683**	-0.533**	8.405**	8.866**	8.635**	1.217**	0.855*	1.036**	-0.792	0.073	-0.360	4.073**	2.831**	3.452**
L.S. D	0.05	0.564	0.527	0.463	5.186	5.521	3.789	1.125	1.215	0.829	2.400	2.127	1.603	1.501	1.833	1.184
Sij	0.01	0.743	0.694	0.609	6.827	7.268	4.987	1.481	1.600	1.091	3.155	2.800	2.110	1.976	2.413	1.558
L.S. D	0.05	0.341	0.237	0.208	2.319	2.470	1.464	0.504	0.545	0.370	1.072	0.951	0.717	0.670	0.819	0.529
Si-Skl	0.01	0.449	0.312	0.273	3.052	3.251	1.927	0.663	0.717	0.489	1.411	1.251	0.944	0.884	1.078	0.697

*,** Significant and highly significant at 0.05 and 0.01 level of probability, respectively.

Table 6. Estimates of specific combining ability effects for grain yield and some of other traits at Gemmeiza, Mallawy and their combined data in 2005 season.

Crosses	Days to 50% silking			Plant height			Ear height			Resistance to late wilt %			Grain yield		
	Gem.	Mall	Comb.	Gem.	Mall	Comb.	Gem.	Mall	Comb.	Gem.	Mall	Comb.	Gem.	Mall	Comb.
Gm. 6 x 1002	-0.440	-0.633	-0.516	-2.872	5.233	1.180	0.346	0.340	0.343	5.654**	2.893*	4.274**	1.756	0.596	1.176
Gm. 6 x 1004	-0.317	-0.050	-0.183	-0.256	-5.283	-3.669	0.044	1.135	0.590	-2.622	-4.261*	-3.442*	-1.414	3.425*	1.005
Gm. 6 x 1021	0.717	0.683	0.700	4.927	0.050	2.488	-0.390	-1.476	-0.933	-3.032	1.368	-0.832	-0.341	-4.021**	-2.181*
Gm. 10x 1002	-0.317	-0.617	-0.517	-0.122	-6.350*	-3.236	-0.300	0.702	0.201	-1.812	-1.615	1.7135	-0.070	-2.005	-1.038
Gm. 10x 1004	0.277	1.616	0.942*	1.694	4.133	2.913	-0.760	-0.784	-0.771	1.661	-0.970	0.3455	-3.908**	-1.331	-2.620*
Gm. 10x 1021	0.050	-0.900*	-0.425	-1.572	2.216	0.322	1.060	0.082	0.571	0.151	2.585	1.368	3.979**	3.337*	3.658**
Gm. 14x 1002	-0.317	-0.633	-0.457	-6.956*	0.066	-3.445	-0.973	-0.749	0.861	3.271**	3.001*	3.136*	5.226**	4.276**	4.751**
Gm. 14x 1004	0.777	0.950*	0.863*	5.861	1.050	3.455	-0.001	0.886	0.443	-4.405*	-0.703	-2.554	-3.864**	-2.919	-3.392**
Gm. 14x 1021	-0.450	-0.316	-0.383	1.094	-1.116	-0.011	0.974	-0.136	0.419	1.134	-2.298	-0.582	-1.361	-1.356	-1.359
Gm. 16x 1002	-0.233	0.200	-0.061	-0.538	0.400	-0.069	-1.316	-1.978**	-1.647*	1.504	-2.515	-0.506	-0.559	-1.322	-0.940
Gm. 16x 1004	0.600	-0.216	0.191	6.277*	-0.616	2.830	1.451	0.620	1.035	1.752	2.930	2.341	3.439*	1.739	2.589*
Gm. 16x 1021	-0.367	-0.016	-0.175	-5.738	0.216	-2.761	-0.135	1.358	0.612	-3.257	-0.415	-1.836	-2.879	-0.416	-1.648
Gm. 17x 1002	0.100	-0.300	-0.100	-6.372	0.316	-3.028	0.239	-1.208	-0.485	-4.318*	-2.315*	-3.317**	-4.644**	-1.888	-3.266**
Gm. 17x 1004	-0.316	0.533	0.108	-0.305	-2.200	-1.252	-0.686	1.132	0.223	1.444	1.655	1.550	-1.225	-1.049	-1.137
Gm. 17x 1021	0.217	-0.233	-0.008	6.677*	1.883	4.280	0.446	0.075	0.261	2.884	0.660	1.772	5.870**	2.938	1.762
Gm. 18x 1002	1.017*	0.283	0.650	2.711	-1.683	0.514	-0.046	0.765	0.360	1.412	2.593	2.003	1.741	-0.916	4.404**
Gm. 18x 1004	-0.400	0.616	0.108	-2.972	-1.950	-2.461	-0.312	0.552	0.120	-1.488	-0.661	-1.048	1.416	0.362	0.889
Gm. 18x 1021	-0.616	-0.900*	-0.758*	0.261	3.633	1.947	0.358	-1.318**	-0.480	0.076	-1.931	-0.930	-3.158*	0.553	-1.302
Gm. 22x 1002	0.433	-0.133	0.150	-4.122	-2.100	-3.111	-0.909	-0.888	-0.899	2.537	-0.281	1.128	7.085**	3.456**	5.270**
Gm. 22x 1004	0.267	-0.300	-0.016	7.444*	0.383	3.914	0.745	-0.489	0.128	-2.263	-0.561	-1.412	-0.148	-0.084	-0.116
Gm. 22x 1021	-0.700	0.433	-0.133	-3.322**	1.716	-0.803	0.164	1.377	0.771	-0.273	0.843	0.285	-6.937**	-3.372**	-5.155**
Gm. 23x 1002	0.767	0.200	0.4835	0.044	-3.350	-1.653	-0.141	0.958	0.409	3.204	4.026*	3.615*	-1.504	3.113*	0.804
Gm. 23x 1004	-0.150	-0.216	-0.183	3.111	8.633*	5.872*	0.192	-2.102*	-0.955	-1.322	-0.778	-1.050	-3.110*	-2.334	-2.722*
Gm. 23x 1021	-0.617	0.016	-0.316	-3.155	-5.283	-4.219	-0.050	1.144	0.547	-1.882	3.248	-2.565	4.615**	-0.778	1.919*
Gm. 25x 1002	-0.983	-0.050	-0.516	3.961	4.816	4.389	0.431	0.015	0.223	-0.228	-0.231	-0.235	-0.494	1.964	0.735
Gm. 25x 1004	0.600	0.283	0.441	-6.222*	-4.950	-5.586*	-0.691	-1.633	-1.162	-1.880	-0.412	-1.145	0.451	-4.039**	-1.794*
Gm. 25x 1021	0.383	-0.233	0.075	2.261	0.133	1.197	0.260	1.617	0.938	2.109	0.643	1.376	0.042	2.074	-1.058

Table 6. Count.

Crosses	Days to 50% silking			Plant height			Ear height			Resistance to late wilt %			Grain yield		
	Gem.	Mall	Comb.	Gem.	Mall	Comb.	Gem.	Mall	Comb.	Gem.	Mall	Comb.	Gem.	Mall	Comb.
Gm. 26 x 1002	0.933	0.700	0.816*	-2.538	0.483	-1.027	2.010*	0.373	1.191	0.646	2.876	1.761	-1.044	-0.202	-0.623
Gm. 26 x 1004	-0.733	-1.216**	-0.974*	-5.472	2.716	-1.378	0.616	-0.397	0.109	1.844	-1.978	-0.067	-0.538	-0.255	-0.397
Gm. 26 x 1021	-0.200	0.516	0.158	8.011	-3.200	2.405	-2.626*	0.024	-1.301	-2.490	-0.898	-1.694	1.582	0.458	1.020
Gm. 27 x 1002	0.517	0.033	0.275	-1.822	-7.933*	-4.903**	-0.426	-0.428	-0.427	-0.112	1.810	0.849	-0.596	0.457	-0.070
Gm. 27 x 1004	-0.400	-0.383	-0.391	4.444	-4.200	0.122	0.342	1.263	0.802	1.336	0.405	0.8705	0.550	-0.933	-0.192
Gm. 27 x 1021	-0.117	0.350	-0.425	-2.572	12.133**	4.781	0.083	-0.835	-0.376	-1.223	-2.215	-1.719	0.046	0.475	0.261
Gm. 29 x 1002	-1.317*	-0.466	-0.891*	5.211	1.733	3.472	0.308	1.116	0.712	-4.995*	-4.906*	-4.95**	1.757	-0.640	0.559
Gm. 29x 1004	0.767	0.366	0.566	-2.222	-3.033	-2.628	-0.516	0.356	-0.080	3.727	0.013	1.87	-4.375**	-0.846	-2.611
Gm. 29x 1021	0.550	0.100	0.325	-2.988	1.300	-0.844	0.702	-1.473	-0.633	1.276	4.893*	3.0845*	2.617*	1.487	2.052*
Gm. 30x 1002	-0.067	0.283	0.108	8.961*	1.816	6.389*	-0.464	1.174	0.355	-4.320*	-1.898	-3.109*	-2.134	0.228	-0.953
Gm. 30x 1004	0.517	0.116	0.316	-12.722**	1.050	-5.836*	1.180	0.138	0.663	2.377	3.871*	3.124*	1.396	-1.877	-0.241
Gm. 30x 1021	-0.450	-0.400	-0.425	3.761	-4.866	-0553	-0.723	-1.312	-1.017	1.942	-1.973	-0.0155	0.737	1.648	1.193
Gm. 31x 1002	-0.450	0.783	0.100	0.044	-1.933	-0.945	-0.402	-0.238	-0.320	-3.537	-2.273	-2.905*	-5.260**	-9.131**	-7.195**
Gm. 31x 1004	-0.650	-1.383**	-1.016*	3.361	4.800	4.080	-0.404	-0.685	-0.545	0.811	3.396	2.1035	-.070	9.792**	9.431**
Gm. 31x 1021	1.633*	0.600	1.116	-3.405	-2.866	-3.135	0.807	0.923	0.865	2.726	-1.023	0.8515	-3.813*	-0.661	-2.237*
Gm. 32x 1002	0.850	0.450	0.650	4.461	6.483	5.472*	1.645	0.043	0.844	1.104	-1.065	0.0195	-1.256	2.014	0.379
Gm. 32x 1004	-0.817	-0.716	-0.766	-0.222	-0.533	-0.377	-1.208	0.008	-0.601	-0.972	-1.995	-1.4585	2.257	0.353	1.305
Gm. 32x 1021	-0.033	0.266	0.116	-4.238	-5.950	-5.094*	-0.436	-0.051	-0.243	-0.132	3.010	1.439	-1.001	-2.367	-1.685
L.S. D 0.05	1. 317	0.915	0.802	8.985	9.563	6.560	1.948	2.107	1.435	4.151	3.683	2.775	2.599	3.175	2.050
Sij 0.01	1.734	1.205	1.055	11.827	12.688	8.635	2. 565	2.774	1.889	5.464	4.848	3.653	3.421	4.180	2.599
L.S. D 0.05	1.862	1.294	1.135	12.705	13.524	9.279	2.756	2.979	2.029	5.872	5.210	3.924	3.675	4.488	2.901
Sij-Skl 0.01	2.451	1.703	1.494	16.723	17.802	12.214	3.628	3.922	2.670	7.729	6.858	5.165	4.838	5.908	3.818

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قوة الهجين والقـــدرة على الائتلاف في الــذرة الصفراء

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تم إجراء التهجين بين خمسة عشر سلالة صفراء من الذرة الشامية مرباة تربيه ذاتية بمحطة بحوث الجميزة مع ثلاثة كشافات هى جميزة(١٠٠٢-١٠٠٤-١٠٢١) في موسم ٢٠٠٤ ثم قيمت الهجـــن القميـــة الناتجة وعددها ٤٥ هجين قمي مع ثلاثة هجن فرديـــة استخدمت كأصناف قياسيـــة وهـــي (هــ . ف ١٥٥ – هــ . ف ٣٠٨٠ – هــ . ف ٣٠٨٤) فـــي محطتي البحوث الزراعية بالجميزة وملوي وذلك في الموسم الصيفـــي٢٠٠٥ .

وأخذت القراءات على صفة المحصول (إردب/فدان)- وتزهير ٥٠% حريره (يـــوم) – ارتفـــاع النبات (سم) – ارتفاع الكوز(سم) والمقاومـــة لمرض الذبول المتأخر كنســـبة مئويـــة وذلـــك للمـــوقعين (الجميزة – ملوي) ومتوسطيما معا.

تم تحليل البيانات حسب الطريقة المقترحة للعالم كمبثورن سنة ١٩٥٧ وكانت النتـــائج المتحصـــل عليها كما يلي:-

١- وجدت اختلافات معنوية بين الموقعين (الجميزة – ملوي) والتباين المشترك بينهمـــا لكـــل الصـــفات المدروســـة ما عدا صفة المقاومة لمرض الذبول المتأخر.
٢- وجدت اختلافات معنوية بين الهجن القمية الناتجة ومجزئاتها وهي السلالات والكشافات بينما تفاعـــل السلالات مع الكشافات كانت معنوية لصفه المحصول والمقاومة لمرض الذبول المتأخر.
٣- كان التفاعل بين السلالات مع المواقع والكشافات مع المواقع معنويا لمحصول الحبوب ، المقاومـــة لمرض الذبول وارتفاع الكوز وغير معنوي لباقي الصفات.
٤- كان التباين الوراثي المضيف لوراثة الصفات المختلفة المدروسة وكذلك التفاعل مع المواقع أكثر أهمية من التباين الوراثي الغير مضيف.
٥- أظهرت السلالات جميزة ١٠ وجميزة ١٤ وجميزة ٢٢ معنوية موجبه وتأثيرات مقبولة للقدرة العامة بالنسبة لمحصول الحبوب كما أظهرت السلالات جميزة ٢٦ – جميزة ٢٩ وجميزة ٣١ تأثيرات معنوية مقبولة للقدرة العامة لصفة التبكير وأعطت السلالة جميزة ٣٠ تأثيرات معنوية مقبولة للقدرة العامـــة بالنسبة لقصر النبات والسلالة جميزة ١٦ لوضع الكوز المنخفض والسلالة جميزة ١٤ أعطت تأثيرات مقبولة للقدرة العامة بالنسبة لصفه المقاومة لمرض الذبول المتأخر.
٦- أظهرت السلالة ١٠٠٢ (الكشاف) تأثيرات معنوية ومقبولة للقدرة العامة بالنسبة لصفة التكبير وقصر النباتات والمقاومة لمرض الذبول المتأخر وأيضا أظهرت السلالة ١٠٢١ (الكشـــاف) تـــأثيرات معنوية وموجبه للقدرة العامة بالنسبة لصفة المحصول.
٧- تفوقت ١٠ هجن قمية على الأقل بالنسبة للهجن التجارية والمستخدمة كأصناف قياسية وهي (هــ . ف ١٥٥ – هــ . ف ٣٠٨٠ – هــ . ف٣٠٨٤) بالنسبة للقدرة المحصولية العالية والصفات الأخرى.
٨- أظهرت بعض الهجن تأثيرات عالية بالنسبة لقوة الهجين كما في الهجـــين (جميـــزة ٣٢ × جميـــزة ١٠٠٤) متبوعا بالهجينين (جميزة ١٧ × جميزة ١٠٢١) و (جميزة ٢٩ × جميزة ١٠٢١) وتعتبـــر هذه الهجن مقبولة وجيده لإمكانية استخدامها في برامج تربية محصول الذرة الشامية.