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Performance and Genetical Analysis of Some New Top Crosses Of Maize under Normal Irrigation and Drought Stress Conditions

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Abstract

Line x tester approach with 12 lines and 3 testers was used to assess maize combining ability. The 36 crosses and two checks were tested under regular irrigation and water shortage in RCBD design with three replications. The topcross L9 x M2 performed best for days to 50% silking, while the cross L7 x CIMMYT14 for grain yield plant^{-1}. Non-additive gene action was predominant for all traits and GCA was more stable under varied environmental conditions than SCA. Lines L5 and L8 had favorable GCA impacts for yield and some related characters. Desirable SCA effects for days to 50% were obtained for the cross L9 x M8. The cross L7 x CIMMYT14 and L11 x M8 gave the best SCA values for grain yield plant^{-1} and one or more other traits. The cross L9 x M8 gave the best heteroboltosis for days to 50% relative to both checks. Moreover, the most desirable heterotic effects for grain yield plant^{-1} were detected for the crosses L5 x M2 under drought stress and combined data and the cross L7 x CIMMYT14 under normal irrigation relative to both checks.

Key words: Maize, Combining ability, heterosis drought.

Introduction

The key to the success of any maize breeding programme is the selection of the best parents for a distinguishing cross. This needs certain critical information about the cross's parents in terms of the type of gene activity governing the economic features in such plant. Several strategies can assist maize breeders in obtaining significant genetic information on the inheritance of investigated characteristics and can be efficiently employed in screening available genetic resources to pick the best parents for a certain cross. One of these strategies is the line x tester model, which provides breeders with critical information on the mechanism of gene activity in the inheritance of many characteristics. It allows breeders to assess general and particular combining capacities, allowing them to determine whether the mode of action responsible for the trait under investigation is additive or non-additive. This is a requirement for launching a successful maize breeding programme. Because it will assist breeders in selecting whether to apply selection if additive is dominant or exploitation of heterosis if non-additive is dominant. As a result, several researchers investigated the nature of gene action in maize and documented the relevance of non-additive gene action in determining critical maize features. Among those are **Sedhom et al. (2012), Aminu *et al.* (2014), and Emam and Mohamed (2021).** Others reported the importance of additive gene action in governing important traits in maize (**Neveen Hamouda *et al.* (2021), Sedhom *et al.* (2021)** and **Yadesa et al (2022)**.).

Corn breeders must develop new maize hybrids with improved levels of drought resistance. This is due to the fact that drought causes severe harm to maize crops, especially if it happens two weeks before or after blooming. Drought also reduces seed set in maize, lengthens the anthesis- silking period due to delayed silk development, and increases plant barrenness, all of which reduce grain yield plant^{-1}(**Bolanos and Edmeades, 1996**).

As a result, the primary goal of this study is to evaluate both forms of combining ability using line x tester analysis, as well as conventional heterosis for five maize characteristics under normal irrigation and drought stress conditions.

Materials and Methods

The line x tester model was applied in this study using twelve new elite inbreds of maize and three distinguished testers for the sake of evaluating combining ability of some traits in maize. This work was undertaken at the Faculty of Agric., Moshtohor during 2021 and 2022 seasons. The parents and testers used in this study were developed from different genetic resources with high degree of variability concerning maize yield productivity and other agronomic traits. The pedigree of these materials is presented in Table 1.

In the first summer season (2021), the twelve inbred lines and the three testers were planted in three planting dates to overcome differences in flowering time during hybridization. At flowering time, enough seeds of 36 crosses were obtained for evaluation process next year.

In 2022 season, 36 crosses with 2 checks (SC 128 and SC 30 k 8) were evaluated in two experiments. The first experiment (E1) is allocated for normal irrigation (irrigation every 12 days) while drought stress treatment was applied to the second experiment (E2) where irrigation water was added every 21 days. In each experiment the statistical design was RCBD design with three replications. Each plot consists of one ridge 6 meter length and the distance between ridges was 70 cm with plants were spaced at 25 cm apart. Nitrogen fertilization, pest control and other cultural practices were done properly as recommended for the maize cultivation area. Grain yield per plant with some other traits namely, days to 50% silking, No. of rows per ear, No. of grains per row, 100 kernel weight were studied.

Table 1. Names, origin, and country of the studied maize entries.

Line #	Parent name	Origin	Country
1	**L1**	**Pioneer 514**	**Egypt**
2	**L2**	**Pioneer 514**	**Egypt**
3	**L3**	**Cairo 1**	**Egypt**
4	**L4**	**Cairo 1**	**Egypt**
5	**L5**	**Cairo 1**	**Egypt**
6	**L6**	**Giza 2**	**Egypt**
7	**L7**	**Giza 2**	**Egypt**
8	**L8**	**Giza 2**	**Egypt**
9	**L9**	**Giza 2**	**Egypt**
10	**L10**	**Giza 2**	**Egypt**
11	**L11**	**Giza 2**	**Egypt**
12	**L12**	**Giza 2**	**Egypt**
Testers			
T1	**M2**	**Cairo 1**	**Egypt**
T2	**M8**	**Pioneer (Taba)**	**Egypt**
T3	**CIMMYT14**	**CIMMYT**	**CIMMYT**

Data were subjected to statistical analysis for all studied traits in each experiment. Combined analysis for both experiments was performed after testing homogeneity of the two environments according to **Steel et al., (1997).** General and specific combining abilities were estimated for all traits according to **Kempthorne (1957).**

Superiority of top crosses (standard heterosis) relative to both check hybrids was estimated for all traits under normal irrigation and drought stress condition as follows:

The relative increase (heterobeltosis) = $\frac{\text{F1 - Check variety}}{\text{Check variety}} \text{X} \, 100$

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 and r refer to the tabulated t value at a stated level of probability and number of replications, respectively.

Results & Discussion

Analysis of variance and mean performance

The statistical analyses for the five studied traits, i.e., days to 50% silking, No. of rows ear^{-1}, No. of grains row^{-1}, 100 kernel weight and grain yield plant^{-1} under two environments as well as combined data are presented in Table 2. It is clear that differences between both environments were significant for all traits with higher mean values of normal irrigation being much higher than those of drought stress condition (Table 3). Such results are expected since drought adversely affects the growth of maize plants during the growth season. Similar results are reported by **Aminu et al. (2014), Vinodhana and Gansan (2017) and Hayati and Sutoyo (2019)**. Also, significant mean squares due to crosses and their partitions were detected for all traits under E1, E2 and combined data (Table 2). Such results reflect the higher degree of variability among maize genotypes used in this work. Moreover, significant mean squares were detected for the interaction between testers and environment for days to 50% silking; between crosses, line and line x crosses and environment for number of rows ear^{-1}; and between crosses, line, testers and line x testers and environment for number of grains row^{-1}, 100 kernel weight and grain yield plant^{-1}. These findings clarified that studied maize genotypes behaved somewhat differently from normal irrigation to drought stress condition. Several investigators reported a great deal of variability among maize entries. Among those **El Gazzar (2021), Sedhom *et al*. (2021), Belay (2022) and Yadesa et al. (2022).**

Mean values for all traits under E1, E2 and combined data are presented in Table 3. Regarding days to 50% silking, the top cross L9 x M2 was the best among all studied crosses since it had negatively and significantly value as compared to the two checks (S.C. 128 and S.C. 30 k 8) under all environments. The cross L12 x CIMMYT14 ranked the second best under normal irrigation and drought stress. For number of rows ear^{-1}, the most desirable mean values were detected for the crosses L2 x M2 under E1 (16.67); L5 x L2 under E2 (16.00) and combined data (16.17). Concerning number of grains row^{-1}, the top cross L5 x M2 gave the highest significant mean values under normal irrigation and combined data being 46.67 and 44.00, respectively as compared to the check varieties, while the to cross L12 x M2 (43.67) produced the best mean value under drought stress condition. For 100 kernel weight, the highest significant mean value were detected for the top cross L12 x CIMMYT14 under normal irrigation and the top cross L11 x M8 under E2 and combined data (Table 3). For grain yield plant^{-1}, the most desirable mean values were detected for the to cross L7 x CIMMYT14 under normal irrigation (259.00g) and combined analysis (212.83 g), while the top cross L5 x M2 gave the highest significant mean value being 204.33 g under drought stress condition as compared to the two check hybrids. Moreover, the top cross L11 M8 ranked the second best under normal irrigation (251.33g) and combined analysis (203.17g).

It could be concluded that the top crosses L1 x CIMMYT14, L5 x M2, L7 x CIMMYT14, L11 x M8 are of great value for maize breeder since they exhibited the best performance.

Combining ability

Mean squares of SCA were more important than those of GCA for all traits meaning the importance of non-additive gene action in controlling these traits (Table 2). Furthermore, the higher values of the interaction of specific combining ability with environment was much more than of general combining ability with environment. This means that GCA was more stable than SCA for these traits. Several researchers reported the importance of non-additive gene action in controlling grain yield and related traits of maize (**Aswin et al. (2020); Emam and Mohamed, 2021 and Sedhom *et al*. 2021**).

The effects of GCA for all studied traits under normal irrigation, drought stress as well as combined analyses are presented in Table 4 and Figures (1-6). The tester M2 was the best for No. of rows ear^{-1} and grain yield plant^{-1} under E1, E2 and combined data (Table 4 and Figs. 1,2,6). The tester M8 was the best for No. of grains row^{-1} under normal irrigation and combined data and 100 kernel weight under drought stress and combined data (Table 4, Fig 4,5). The tester CIMMYT14 was superior for days to 50% silking under normal irrigation and combined data and No. of grains row^{-1} under drought stress and combined data since it expressed the best GCA effects for this trait. Regarding days to 50% silking the best general combiner was the inbred line L9 since it had the highest negative and significant effects under normal irrigation (-1.85**), drought stress (-1.31**) and combined data (-1.58**) (Table 4 and Fig. 1). Concerning No. of rows ear^{-1}, The highest desirable GCA effects were detected for the line L5 under normal irrigation and Line L2 under drought stress and combined data (Table 4 and Fig. 2). For No. of grains row^{-1}, the inbred lines L7 under normal irrigation and L9 under drought stress and combined data expressed the highest positive and significant GCA effects (Fig. 3). Parental inbred line L9 under normal irrigation and L8 under drought stress and combined data demonstrated the best GCA effects for 100 kernel weight (Fig. 5). Parents L8 and L5 seemed to be the best general combiner for grain yield plant^{-1} since they expressed the highest positive and significant GCA effects being 22.76** (for L8 under normal irrigation) and 24.89** and 16.66** (for L5 under drought stress and combined data, respectively).

Specific combining ability for all traits in the first and second experiments are presented in Table 5. The top crosses L1 x M2, L12 x CIMMYT14 and L9 x M8 exhibited the most desirable SCA for days to 50% silking under normal irrigation (-1.37*), drought stress (-1.96**) and combined data (-1.50**). For number of rows ear^{-1}, the highest positive and significant SCA effects were detected for the crosses L12 x M8 (under E1 recording 1.89**) and L11 x M8 (under E2 and combined data being 2.07** and 1.87**, respectively). Regarding number of grains row^{-1}, The most desirable SCA effects were obtained for the top crosses L5 x M2 under normal irrigation and combined analysis. Concerning 100 kernel weight, the top cross L1 x CIMMYT14 gave the best SCA effects under normal irrigation, drought stress and combined analysis being 8.81**, 7.01** and 7.91**, respectively. For grain yield plant^{-1}, the most desirable SCA effects were detected for the cross L7 x CIMMYT14 under normal irrigation (74.33**) and combined data (45.77**) and L11 x M8 under drought stress conditions (31.11**). The cross L12 x M2 ranked the second best for grain yield plant^{-1} since it had SCA effects of 70.46**, 10.78** and 40.62** under E1, E2 and combined data, respectively.

In general, the studied top crosses L7 x CIMMYT14, L11 x L8, L1 x CIMMYT14 and L12 x M2 seemed to be the best among all studied cross since they had the most desirable effects for yield and some of its components and they would have a great value in future maize programs.

Table 2: Analysis of variance for days to 50% silking, plant height, No. of rows ear^{-1}, No. of kernels row^{-1}, 100 kernel weight and grain yield plant^{-1} under normal irrigation and drought stress as well as combined data.

S.O.V	df		Days to 50% silking			No. of rows ear^{-1}			No. of grains row^{-1}			100 kernel weight			Grain yield (g) plant^{-1}		
	S	C	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Environment (E)		1			528.91**			52.02**			860.00**			416.67**			176931.13**
Rep	2		0.26	0.84		1.69	2.70		2.29	2.01		3.90	7.26		148.68**	44.19	
Rep/E		4			0.55			2.20			2.15			5.58			96.44**
Crosses	35	35	3.46**	3.29**	5.54**	5.30**	5.74**	8.50**	46.31**	54.89**	74.06**	85.52**	65.39**	139.38**	4521.40**	2064.21**	4250.12**
Lines	11	11	4.69**	3.31**	7.43**	4.19**	3.70*	5.22**	41.54**	65.16**	71.89**	83.96**	43.73**	111.20**	2109.63**	2067.94**	2373.83**
Testers	2	2	12.4**	4.73**	13.63**	17.69**	18.81**	36.14**	112.06**	14.06*	30.50**	165.62**	113.62**	263.37**	6711.01**	5812.00**	10125.50**
Lines x testers	22	22	2.02*	3.16**	3.86**	4.73**	5.56**	7.62**	42.71**	53.47**	79.11**	79.01**	71.83**	142.20**	5528.22**	1721.64**	4654.15**
Crosses x E		35			1.21			2.54**			27.14**			11.52**			2335.48**
Line x E		11			0.57			2.68*			34.81**			16.49**			1803.75**
Testers x E		2			3.50*			0.37			95.63**			15.88*			2397.50**
Line x Testers x E		22			1.32			2.67*			17.07**			8.64*			2595.71**
Error	70	140	1.02	0.74	0.88	1.09	1.75	1.42	2.44	3.93	3.19	5.28	4.96	5.12	10.43	18.61	14.52
variance GCA			0.02	0.00	0.01	0.01	0.00	0.01	0.06	0.02	0.04	0.10	0.10	0.02	15.85	5.39	3.18
variance SCA			0.33	0.81	0.50	1.21	1.27	1.03	13.42	16.51	12.65	24.58	22.29	22.85	1839.26	567.67	773.27
GCA x E					0.03			0.05			2.14			0.34			22.00
SCA x E					0.64			1.45			17.28			24.02			1633.66

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

Table 3: Mean performance of crosses and check varieties for days to 50% silking, No. of rows ear^{-1}, No. of kernel row^{-1}, 100 kernel weight and grain yield plant^{-1} under normal irrigation and drought stress as well as combined data.

Genotypes	Days to 50% silking			No. of rows ear^{-1}			No. of grains row^{-1}			100 kernel weight			Grain yield (g) plant^{-1}		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
L1 x M2	59.00	62.33	60.67	15.33	12.00	13.67	31.33	31.00	31.17	41.00	40.00	40.50	155.33	135.67	145.50
L1 x M8	62.00	64.67	63.33	12.67	12.67	12.67	41.00	40.67	40.83	41.33	40.33	40.83	198.00	124.00	161.00
L1 x CIMMYT14	60.33	64.00	62.17	16.67	14.67	15.67	41.67	40.33	41.00	56.67	51.33	54.00	247.67	153.33	200.50
L2 x M2	59.67	62.00	60.83	16.00	15.33	15.67	34.67	34.33	34.50	41.67	39.67	40.67	169.33	154.67	162.00
L2 x M8	61.67	64.00	62.83	14.67	14.67	14.67	41.33	26.00	33.67	52.33	51.33	51.83	183.67	172.33	178.00
L2 x CIMMYT14	59.67	63.67	61.67	16.00	15.33	15.67	41.00	38.33	39.67	54.00	50.00	52.00	203.67	130.00	166.83
L3 x M2	59.00	62.67	60.83	16.00	15.33	15.67	40.67	32.67	36.67	41.67	40.33	41.00	208.33	146.33	177.33
L3 x M8	61.00	64.00	62.50	12.67	12.00	12.33	43.67	36.00	39.83	47.33	46.00	46.67	185.67	134.33	160.00
L3 x CIMMYT14	60.33	64.33	62.33	12.67	12.00	12.33	36.00	35.33	35.67	51.33	50.67	51.00	148.00	110.00	129.00
L4 x M2	61.00	62.33	61.67	16.00	15.33	15.67	39.33	36.00	37.67	45.00	44.33	44.67	221.00	140.00	180.50
L4 x M8	60.67	64.33	62.50	14.00	13.33	13.67	41.33	33.33	37.33	52.33	51.33	51.83	191.67	132.67	162.17
L4 x CIMMYT14	60.33	63.67	62.00	15.33	12.00	13.67	39.00	30.67	34.83	44.00	43.00	43.50	208.33	113.33	160.83
L5 x M2	61.67	63.00	62.33	16.33	16.00	16.17	46.67	41.33	44.00	55.33	52.33	53.83	244.67	204.33	224.50
L5 x M8	61.67	64.00	62.83	16.00	10.67	13.33	42.00	35.00	38.50	52.33	46.67	49.50	216.33	124.67	170.50
L5 x CIMMYT14	60.33	64.67	62.50	14.67	14.00	14.33	34.00	33.33	33.67	50.00	48.33	49.17	158.67	156.33	157.50
L6 x M2	61.33	65.33	63.33	14.67	14.67	14.67	31.67	31.33	31.50	41.33	40.33	40.83	204.00	111.67	157.83
L6 x M8	61.67	64.00	62.83	12.00	11.33	11.67	44.00	35.67	39.83	53.00	47.67	50.33	211.00	152.67	181.83
L6 x CIMMYT14	61.00	63.67	62.33	15.33	14.67	15.00	35.33	35.00	35.17	54.67	52.33	53.50	140.00	136.00	138.00
L7 x M2	61.00	64.00	62.50	15.33	14.67	15.00	41.33	28.33	34.83	51.67	50.00	50.83	178.33	176.00	177.17
L7 x M8	61.33	66.00	63.67	13.33	12.67	13.00	44.67	31.00	37.83	51.33	50.33	50.83	164.00	128.33	146.17
L7 x CIMMYT14	60.67	64.00	62.33	17.00	14.67	15.83	44.67	40.33	42.50	57.33	47.67	52.50	259.00	166.67	212.83
L8 x M2	61.67	64.33	63.00	14.67	14.00	14.33	40.67	39.33	40.00	52.33	51.67	52.00	215.00	188.67	201.83
L8 x M8	61.00	63.67	62.33	15.33	14.67	15.00	36.67	32.00	34.33	52.67	51.67	52.17	236.33	105.67	171.00
L8 x CIMMYT14	59.67	63.00	61.33	14.67	14.00	14.33	36.33	36.00	36.17	54.67	53.67	54.17	199.33	140.00	169.67
L9 x M2	59.33	63.33	61.33	16.00	12.67	14.33	43.67	35.00	39.33	56.00	53.00	54.50	244.67	107.33	176.00
L9 x M8	58.00	61.00	59.50	13.33	12.67	13.00	42.00	41.67	41.83	53.33	47.67	50.50	198.67	103.33	151.00
L9 x CIMMYT14	58.67	62.67	60.67	14.00	12.67	13.33	44.33	42.67	43.50	53.67	48.00	50.83	193.67	109.33	151.50
L10 x M2	61.67	64.00	62.83	16.00	15.33	15.67	42.00	41.00	41.50	45.00	44.33	44.67	177.33	176.67	177.00
L10 x M8	61.67	64.00	62.83	12.67	12.00	12.33	44.67	37.67	41.17	53.67	52.33	53.00	241.00	122.33	181.67
L10 x CIMMYT14	60.00	64.67	62.33	14.67	14.00	14.33	42.00	40.33	41.17	47.67	47.33	47.50	131.33	100.00	115.67
L11 x M2	59.00	62.33	60.67	14.67	12.67	13.67	40.00	39.00	39.50	48.33	46.33	47.33	179.00	125.67	152.33
L11 x M8	62.00	64.00	63.00	16.00	15.33	15.67	45.33	41.67	43.50	57.00	56.33	56.67	251.33	155.00	203.17
L11 x CIMMYT14	59.00	63.67	61.33	14.67	14.00	14.33	36.00	35.33	35.67	41.33	36.67	39.00	127.00	112.00	119.50
L12 x M2	61.00	64.00	62.50	12.67	15.33	14.00	44.00	43.67	43.83	56.33	46.00	51.17	245.67	151.67	198.67
L12 x M8	61.00	64.67	62.83	14.67	14.00	14.33	40.67	39.00	39.83	49.67	48.33	49.00	126.67	103.33	115.00
L12 x CIMMYT14	59.67	61.33	60.50	13.33	13.33	13.33	36.67	36.33	36.50	58.00	48.00	53.00	125.00	123.67	124.33
SC 128	60.67	63.67	62.17	14.00	13.33	13.67	40.67	37.33	39.00	47.67	45.00	46.33	205.33	156.67	181.00
SC 30K8	60.67	64.00	62.33	14.67	14.00	14.33	42.33	38.00	40.17	50.00	44.67	47.33	208.67	160.00	184.33
LSD 5%	1.64	1.37	1.06	1.69	2.18	1.37	2.59	3.21	2.05	3.65	3.54	2.53	5.18	10.01	5.61
LSD 1%	2.18	1.82	1.40	2.25	2.90	1.81	3.45	4.28	2.71	4.86	4.71	3.33	6.90	13.33	7.39

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

Table 4. General combining ability effects for days to 50% silking, No. of rows ear^{-1}, No. of kernels row^{-1}, 100 kernel weight and grain yield plant^{-1} under normal irrigation and drought stress as well as combined data.

Genotypes	Days to 50% silking			No. of rows ear^{-1}			No. of grains row^{-1}			100 kernel weight			Grain yield (g) plant^{-1}		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
Testers															
T1 (M2)	-0.07	-0.34*	-0.21	0.58**	0.70**	0.64**	-0.62*	-0.21	-0.42	-2.45**	-1.95**	-2.20**	9.43**	14.67**	12.05**
T2 (M8)	0.62**	0.38**	0.50**	-0.78**	-0.74**	-0.76**	1.99**	-0.49	0.75**	0.94*	1.52**	1.23**	6.23**	-7.00**	-0.38
T3 CIMMYT14	-0.55**	-0.04	-0.29*	0.19	0.04	0.12	-1.37**	0.70*	-0.33	1.52**	0.44	0.98**	-15.66**	-7.67**	-11.66**
L.S.D. (gi) 5%	0.34	0.29	0.23	0.35	0.44	0.25	0.52	0.66	0.44	0.76	0.74	0.57	1.07	1.43	0.95
L.S.D. (gi) 1%	0.45	0.38	0.30	0.46	0.58	0.33	0.69	0.88	0.59	1.01	0.98	0.76	1.43	1.90	1.26
L.S.D. (gi-gj) 5%	0.48	0.40	0.32	0.49	0.62	0.35	0.73	0.93	0.62	1.08	1.05	0.81	1.52	2.03	1.34
L.S.D. (gi-gj) 1%	0.63	0.54	0.43	0.65	0.83	0.47	0.97	1.24	0.83	1.43	1.39	1.08	2.02	2.69	1.78
Lines															
L1	-0.07	0.02	-0.03	0.17	-0.63	-0.23	-2.29**	1.04	-0.63	-4.09**	-3.76**	-3.93**	6.20**	0.78	3.49**
L2	-0.19	-0.43	-0.31	0.83*	1.37**	1.10**	-1.29*	-3.41**	-2.35**	-1.09	-0.65	-0.87	-8.57**	15.44**	3.44**
L3	-0.41	0.02	-0.19	-0.94**	-0.63	-0.79**	-0.18	-1.63*	-0.90*	-3.65**	-1.98**	-2.81**	-13.46**	-6.67**	-10.06**
L4	0.15	-0.20	-0.03	0.39	-0.19	0.10	-0.40	-2.96**	-1.68**	-3.31**	-1.43	-2.37**	12.87**	-8.22**	2.32*
L5	0.70*	0.24	0.47*	0.94**	-0.19	0.38	0.60	0.26	0.43	2.13**	1.46	1.80**	12.43**	24.89**	18.66**
L6	0.81*	0.69*	0.75**	-0.72*	-0.19	-0.45	-3.29**	-2.30**	-2.79**	-0.76	-0.87	-0.81	-9.13**	-3.44*	-6.29**
L7	0.48	1.02**	0.75**	0.50	0.26	0.38	3.27**	-3.07**	0.10	3.02**	1.69*	2.35**	6.31**	20.11**	13.21**
L8	0.26	0.02	0.14	0.17	0.48	0.32	-2.40**	-0.52	-1.46**	2.80**	4.69**	3.74**	22.76**	7.89**	15.32**
L9	-1.85**	-1.31**	-1.58**	-0.28	-1.07*	-0.68**	3.05**	3.48**	3.26**	3.91**	1.91*	2.91**	18.20**	-30.22**	-6.01**
L10	0.59	0.57*	0.58*	-0.28	0.04	-0.12	2.60**	3.37**	2.99**	-1.65*	0.35	-0.65	-10.91**	-3.89**	-7.40**
L11	-0.52	-0.31	-0.42	0.39	0.26	0.32	0.16	2.37**	1.26**	-1.54*	-1.20	-1.37*	-8.35**	-6.00**	-7.18**
L12	0.04	-0.31	-0.14	-1.17**	0.48	-0.34	0.16	3.37**	1.76**	4.24**	-0.20	2.02**	-28.35**	-10.67**	-19.51**
L.S.D. (gi) 5%	0.67	0.57	0.45	0.70	0.88	0.50	1.04	1.32	0.88	1.53	1.48	1.15	2.15	2.87	1.90
L.S.D. (gi) 1%	0.89	0.76	0.60	0.92	1.17	0.67	1.38	1.75	1.17	2.03	1.97	1.53	2.85	3.81	2.52
L.S.D. (gi-gj) 5%	0.95	0.81	0.64	0.98	1.24	0.71	1.47	1.86	1.25	2.16	2.09	1.63	3.04	4.06	2.68
L.S.D. (gi-gj) 1%	1.26	1.07	0.85	1.31	1.65	0.94	1.95	2.48	1.66	2.87	2.78	2.16	4.03	5.39	3.56

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

Table 5. Specific combining ability effects for days to 50% silking, No. of rows ear^{-1}, No. of kernels row^{-1}, 100 kernel weight and grain yield plant^{-1} under normal irrigation and drought stress as well as combined data.

Genotypes	Days to 50% silking			No. of rows ear^{-1}			No. of grains row^{-1}			100 kernel weight			Grain yield (g) plant^{-1}		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
L1 x M2	-1.37*	-0.99*	-1.18**	-0.14	-1.81*	-0.98*	-6.05**	-6.12**	-6.08**	-2.88*	-1.94	-2.41*	-54.43**	-16.67**	-35.55**
L1 x M8	0.94	0.62	0.78	-1.44*	0.30	-0.57	1.01	3.82**	2.42**	-5.94**	-5.07**	-5.50**	-8.56**	-6.67**	-7.62**
L1 x CIMMYT14	0.44	0.37	0.40	1.58*	1.52	1.55**	5.04**	2.30*	3.67**	8.81**	7.01**	7.91**	62.99**	23.33**	43.16**
L2 x M2	-0.59	-0.88	-0.74	-0.14	-0.48	-0.31	-3.71**	1.66	-1.03	-5.21**	-5.38**	-5.30**	-25.65**	-12.33**	-18.99**
L2 x M8	0.71	0.40	0.56	-0.11	0.30	0.09	0.34	-6.40**	-3.03**	2.06	2.81*	2.44*	-8.12**	27.00**	9.44**
L2 x CIMMYT14	-0.12	0.48	0.18	0.25	0.19	0.22	3.37**	4.74**	4.06**	3.15*	2.56	2.86**	33.77**	-14.67**	9.55**
L3 x M2	-1.04	-0.66	-0.85*	1.64**	1.52	1.58**	1.18	-1.79	-0.31	-2.66*	-3.38*	-3.02**	18.24**	1.44	9.84**
L3 x M8	0.27	-0.05	0.11	-0.33	-0.37	-0.35	1.56	1.82	1.69*	-0.38	-1.19	-0.78	-1.23	11.11**	4.94**
L3 x CIMMYT14	0.77	0.70	0.74	-1.31*	-1.15	-1.23**	-2.74**	-0.04	-1.39	3.04*	4.56**	3.80**	-17.01**	-12.56**	-14.78**
L4 x M2	0.41	-0.77	-0.18	0.31	1.07	0.69	0.06	2.88*	1.47	0.34	0.06	0.20	4.57*	-3.33	0.62
L4 x M8	-0.62	0.51	-0.06	-0.33	0.52	0.09	-0.55	0.49	-0.03	4.29**	3.59**	3.94**	-21.56**	11.00**	-5.28**
L4 x CIMMYT14	0.21	0.26	0.24	0.03	-1.59*	-0.78	0.48	-3.37**	-1.44	-4.63**	-3.66**	-4.14**	16.99**	-7.67**	4.66**
L5 x M2	0.52	-0.55	-0.01	0.08	1.74*	0.91*	6.40**	4.99**	5.69**	5.23**	5.18**	5.20**	28.69**	27.89**	28.29**
L5 x M8	-0.18	-0.27	-0.22	1.11	-2.15**	-0.52	-0.88	-1.06	-0.97	-1.16	-3.96**	-2.56*	3.55	-30.11**	-13.28**
L5 x CIMMYT14	-0.34	0.81	0.24	-1.19	0.41	-0.39	-5.52**	-3.93**	-4.72**	-4.07**	-1.21	-2.64*	-32.23**	2.22	-15.00**
L6 x M2	0.07	1.34**	0.71	0.08	0.41	0.25	-4.71**	-2.45*	-3.58**	-5.88**	-4.49**	-5.19**	9.57**	-36.44**	-13.44**
L6 x M8	-0.29	-0.71	-0.50	-1.22*	-1.48	-1.35**	5.01**	2.16	3.58**	2.40	-0.63	0.88	19.77**	26.22**	23.00**
L6 x CIMMYT14	0.21	-0.63	-0.21	1.14	1.07	1.11*	-0.30	0.30	0.00	3.48*	5.12**	4.30**	-29.34**	10.22**	-9.56**
L7 x M2	0.07	-0.32	-0.13	-0.47	-0.04	-0.25	-1.60	-4.68**	-3.14**	0.68	2.62*	1.65	-31.54**	4.33	-13.60**
L7 x M8	-0.29	0.95	0.33	-1.11	-0.59	-0.85	-0.88	-1.73	-1.31	-3.05*	-0.52	-1.78	-42.68**	-21.67**	-32.17**
L7 x CIMMYT14	0.21	-0.63	-0.21	1.58*	0.63	1.11*	2.48**	6.41**	4.44**	2.37	-2.10	0.13	74.21**	17.33**	45.77**
L8 x M2	0.96	1.01*	0.99*	-0.81	-0.93	-0.87	3.40**	3.77**	3.58**	1.56	1.29	1.43	-11.31**	29.22**	8.95**
L8 x M8	-0.40	-0.38	-0.39	1.22*	1.19	1.20**	-3.21**	-3.29**	-3.25**	-1.49	-2.19	-1.84	13.21**	-32.11**	-9.45**
L8 x CIMMYT14	-0.56	-0.63	-0.60	-0.42	-0.26	-0.34	-0.19	-0.48	-0.33	-0.07	0.90	0.41	-1.90	2.89	0.50
L9 x M2	0.74	1.34**	1.04*	0.97	-0.70	0.13	0.95	-4.56**	-1.81*	4.12**	5.40**	4.76**	22.91**	-14.00**	4.45**
L9 x M8	-1.29*	-1.71**	-1.50**	-0.33	0.74	0.20	-3.32**	2.38*	-0.47	-1.94	-3.41**	-2.67**	-19.90**	3.67	-8.12**
L9 x CIMMYT14	0.55	0.37	0.46	-0.64	-0.04	-0.34	2.37*	2.19	2.28**	-2.19	-1.99	-2.09*	-3.01	10.33**	3.66*
L10 x M2	0.63	0.12	0.38	0.97	0.85	0.91*	-0.27	1.55	0.64	-1.32	-1.71	-1.52	-15.31**	29.00**	6.84**
L10 x M8	-0.06	-0.60	-0.33	-1.00	-1.04	-1.02*	-0.21	-1.51	-0.86	3.95**	2.81*	3.38**	51.55**	-3.67	23.94**
L10 x CIMMYT14	-0.56	0.48	-0.04	0.03	0.19	0.11	0.48	-0.04	0.22	-2.63	-1.10	-1.87	-36.23**	-25.33**	-30.78**
L11 x M2	-0.93	-0.66	-0.79*	-1.03	-2.04**	-1.53**	0.18	0.55	0.36	1.90	1.84	1.87	-16.20**	-19.89**	-18.05**
L11 x M8	1.38*	0.29	0.83*	1.67**	2.07**	1.87**	2.90**	3.49**	3.19**	7.18**	8.37**	7.77**	59.32**	31.11**	45.22**
L11 x CIMMYT14	-0.45	0.37	-0.04	-0.64	-0.04	-0.34	-3.07**	-4.04**	-3.56**	-9.07**	-10.21**	-9.64**	-43.12**	-11.22**	-27.17**
L12 x M2	0.52	1.01*	0.76	-1.47*	0.41	-0.53	4.18**	4.21**	4.19**	4.12**	0.51	2.31*	70.46**	10.78**	40.62**
L12 x M8	-0.18	0.95	0.39	1.89**	0.52	1.20**	-1.77	-0.18	-0.97	-5.94**	-0.63	-3.28**	-45.34**	-15.89**	-30.62**
L12 x CIMMYT14	-0.34	-1.96**	-1.15**	-0.42	-0.93	-0.67	-2.41**	-4.04**	-3.22**	1.81	0.12	0.97	-25.12**	5.11*	-10.00**
L.S.D. (gi) 0.05	1.16	0.99	0.79	1.20	1.52	0.87	1.80	2.28	1.53	2.65	2.57	1.99	3.72	4.97	3.29
0.01	1.54	1.31	1.05	1.60	2.02	1.15	2.39	3.03	2.03	3.51	3.41	2.64	4.94	6.60	4.36
L.S.D. (gi-gj) 0.05	1.65	1.40	1.11	1.70	2.16	1.23	2.54	3.23	2.16	3.74	3.63	2.82	5.26	7.03	4.65
0.01	2.18	1.86	1.48	2.26	2.86	1.63	3.38	4.29	2.87	4.97	4.82	3.74	6.98	9.33	6.17

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

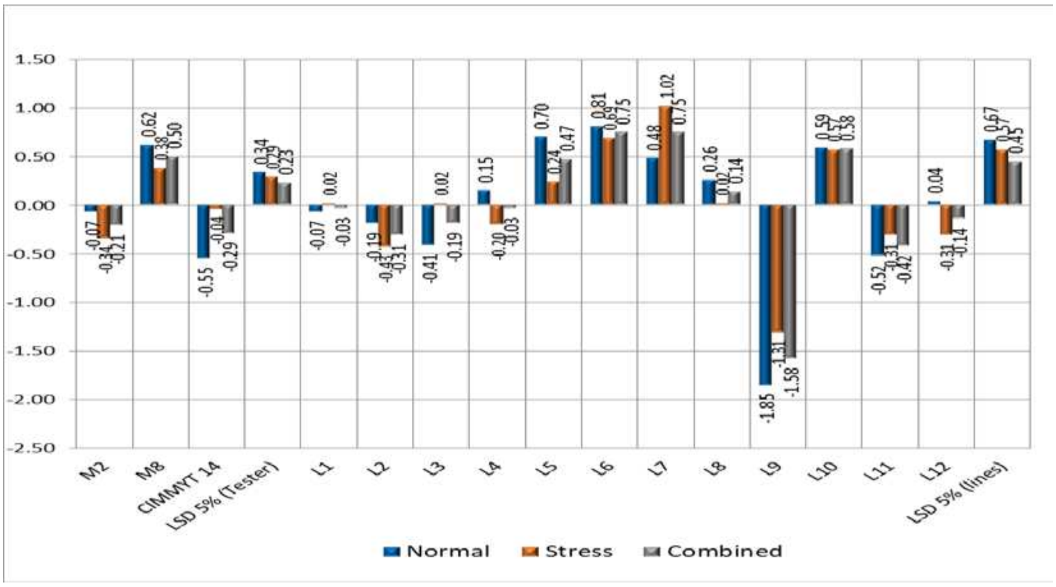

Fig. (1): GCA effects for days to 50% silking under normal irrigation and drought stress as well as combined data.

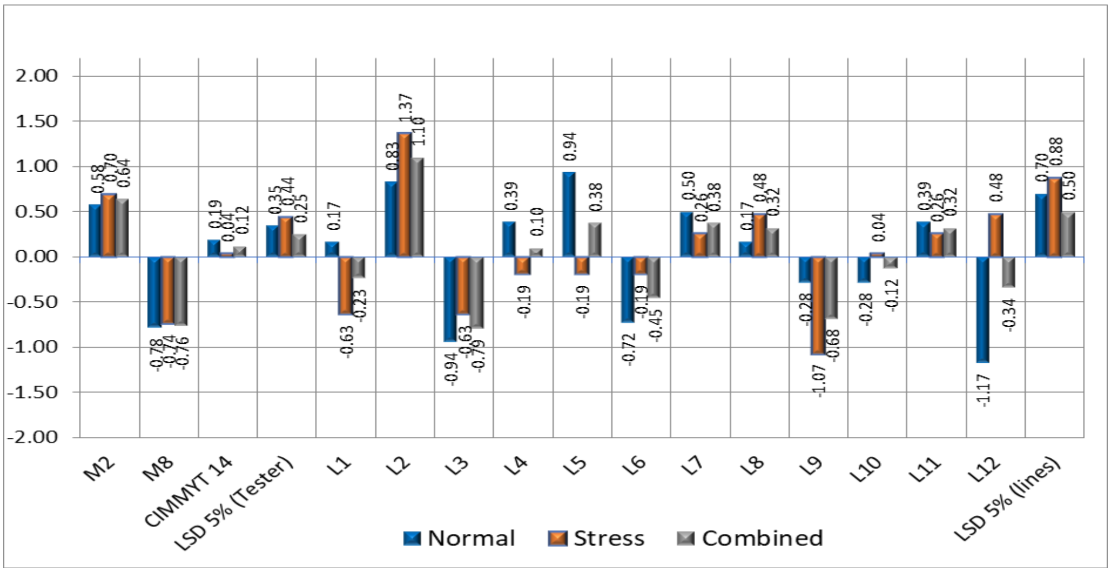

Fig. (2): GCA effects for number of rows ear^{-1} under normal irrigation and drought stress as well as combined data.

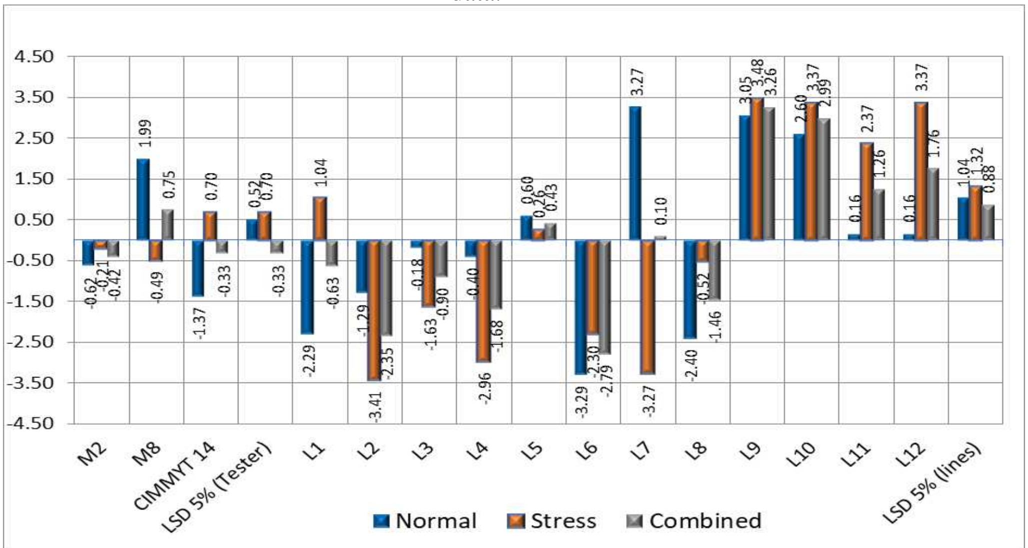

Fig. (3): GCA effects for number of grains row^{-1} under normal irrigation and drought stress as well as combined data.

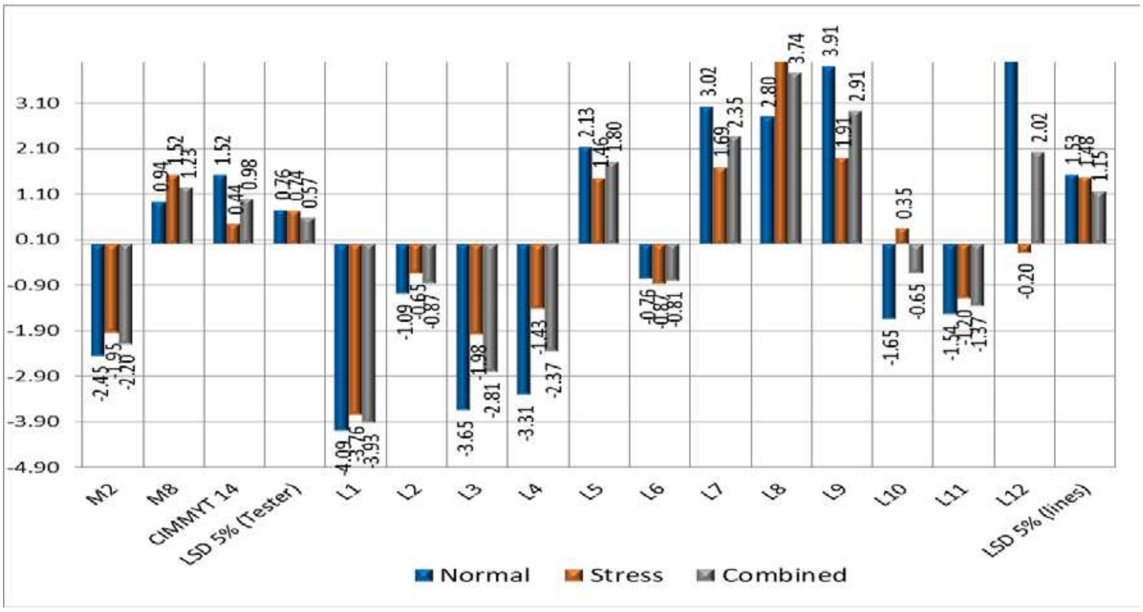

Fig. (4): GCA effects for 100 kernel weight under normal irrigation and drought stress as well as combined data.

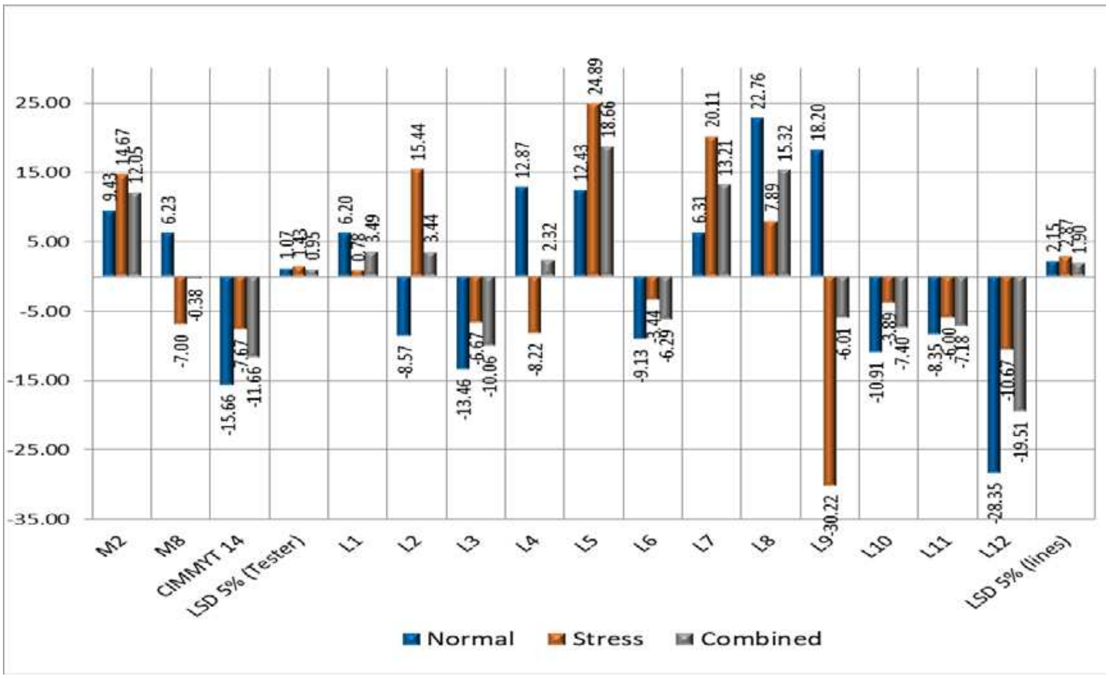

Fig. (5): GCA effects for grain yield plant^{-1} under normal irrigation and drought stress as well as combined data.

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Heterosis

Tables 6 and 7 show the superiority of the examined crosses for all characteristics over S.C. 128 and S.C 30 k under normal irrigation, drought stress, and combination analyses. Under E1, E2, and combined data, five, three, and two crosses, respectively, showed negative and significant heterotic effects for days to 50% silking compared to S.C 128 (Table 6). However, in comparison to both tests and in both conditions, the top cross L9 x M8 produced the most favorable heterotic effects for this feature. Developing early maturity maize varieties is of prime importance to escape destructive injuries caused by *Sesamia cretica ledi chilo simplex* and *Pyrausta nubilialis*. These results are in line with those obtained by **Youstina Sedhom *et al.* (2017)** and **Patil *et al* (2020)** and **El-Hosary (2020).**

For number of rows ear^{-1}, desirable heterotic values relative to S.C. 128 were detected for eleven, eight and nine crosses under normal irrigation, drought stress and combined analysis, respectively (Table 6). The respective values for No. of rows ear^{-1} relative to S.C. 30 k 8 were detected for tw0, one and one crosses. However, the cross L5 x M2 gave the best heterotic effects relative to both checks under stress condition and combined data.

For number of grains row^{-1}, ten, ten and six crosses exhibited positive and significant heterotic effects relative to S.C. 128 and two, seven and four crosses relative to S.C. 30 8 under normal irrigation, drought stress and combined data, respectively. Moreover, the best heterotic effect was detected for the cross L5 x M2 relative SC 128 (12.82**) and the cross L12 x M2 and relative to SC 30 k8 (9.13**).

Regarding 100 kernel weight, desirable heterotic effects were detected for twenty two, fifteen and twenty crosses relative to SC 128 and twelve, eighteen and sixteen crosses relative to SC 30 k 8 under E1, E2 and combined data, respectively (Table 7). However, the to cross L11 x M8 gave the best heterotic effect for 100 kernel weight relative to both checks under drought stress and combined data.

For grain yield plant^{-1}, thirteen, six and six crosses gave positive and significant heterotic effects relive to SC 128 under normal irrigation, drought stress and combined data, respectively. The respective crosses relative to SC 30 k 8 were eleven, six and six. However, the best heterotic effects for grain yield plant^{-1} were detected for the cross L5 x M2 recording 24.03** and 24.03** relative to SC 128 and 27.71** and 21.79** relative to SC 30 k 8 under drought stress and combined data, respectively. The top cross L7 x CIMMYT14 expressed the best heterotic effect relative to SC 128 (26.14**) and SC 30 k 8 (24.12**) under normal irrigation (Table 7). Similar results were obtained by **Youstina Sedhom *et al*. (2017), Emam and Mohamed (2021), Sedhom *et al*. (2021) and Yadesa et al. (2022).**

From such results it could be concluded that the crosses L5 x M2, L7 x CIMMYT14, L11 x M8 had a great value for corn breeders and would be perspective in future maize breeding program.

Table 6: Standard heterosis for days to 50% silking, plant height, and No. of rows ear^{-1} relative to S.C. 128 and S.C. 30 k 8 under normal irrigation, drought stress as well as combined data.

Genotypes	Days to 50% silking						No. of rows ear^{-1}						No. of grains row^{-1}					
	Relative to S.C. 128			Relative to S.30 k8			Relative to S.C. 128			Relative to S.C. 30 k8			Relative to S.C. 128			Relative to S.C. 30 k8		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
L1 x M2	-2.75*	-2.09	-2.41	-2.75*	-2.60*	-2.67*	9.52	-10.00	0.00	4.55	-14.29*	-4.65	-22.95**	-16.96**	-20.09**	-25.98**	-18.42**	-22.41**
L1 x M8	2.20	1.57	1.88	2.20	1.04	1.60	-9.52	-5.00	-7.32	-13.64*	-9.52	-11.63	0.82	8.93*	4.70	-3.15	7.02*	1.66
L1 x CIMMYT14	-0.55	0.52	0.00	-0.55	0.00	-0.27	19.05**	10.00	14.63*	13.64*	4.76	9.30	2.46	8.04*	5.13	-1.57	6.14	2.07
L2 x M2	-1.65	-2.62*	-2.14	-1.65	-3.13*	-2.41	14.29*	15.00*	14.63*	9.09	9.52	9.30	-14.75**	-8.04*	-11.54**	-18.11**	-9.65**	-14.11**
L2 x M8	1.65	0.52	1.07	1.65	0.00	0.80	4.76	10.00	7.32	0.00	4.76	2.33	1.64	-30.36**	-13.68**	-2.36	-31.58**	-16.18**
L2 x CIMMYT14	-1.65	0.00	-0.80	-1.65	-0.52	-1.07	14.29*	15.00*	14.63*	9.09	9.52	9.30	0.82	2.68	1.71	-3.15	0.88	-1.24
L3 x M2	-2.75*	-1.57	-2.14	-2.75*	-2.08	-2.41	14.29*	15.00*	14.63*	9.09	9.52	9.30	0.00	-12.50**	-5.98	-3.94	-14.04**	-8.71**
L3 x M8	0.55	0.52	0.54	0.55	0.00	0.27	-9.52	-10.00	-9.76	-13.64*	-14.29*	-13.95*	7.38*	-3.57	2.14	3.15	-5.26	-0.83
L3 x CIMMYT14	-0.55	1.05	0.27	-0.55	0.52	0.00	-9.52	-10.00	-9.76	-13.64*	-14.29*	-13.95*	-11.48**	-5.36	-8.55*	-14.96**	-7.02*	-11.20**
L4 x M2	0.55	-2.09	-0.80	0.55	-2.60*	-1.07	14.29*	15.00*	14.63*	9.09	9.52	9.30	-3.28	-3.57	-3.42	-7.09*	-5.26	-6.22
L4 x M8	0.00	1.05	0.54	0.00	0.52	0.27	0.00	0.00	0.00	-4.55	-4.76	-4.65	1.64	-10.71**	-4.27	-2.36	-12.28**	-7.05*
L4 x CIMMYT14	-0.55	0.00	-0.27	-0.55	-0.52	-0.53	9.52	-10.00	0.00	4.55	-14.29*	-4.65	-4.10	-17.86**	-10.68**	-7.87*	-19.30**	-13.28**
L5 x M2	1.65	-1.05	0.27	1.65	-1.56	0.00	16.67**	20.00**	18.29**	11.36	14.29*	12.79*	14.75**	10.71**	12.82**	10.24**	8.77*	9.54**
L5 x M8	1.65	0.52	1.07	1.65	0.00	0.80	14.29*	-20.00**	-2.44	9.09	-23.81**	-6.98	3.28	-6.25	-1.28	-0.79	-7.89*	-4.15
L5 x CIMMYT14	-0.55	1.57	0.54	-0.55	1.04	0.27	4.76	5.00	4.88	0.00	0.00	0.00	-16.39**	-10.71**	-13.68**	-19.69**	-12.28**	-16.18**
L6 x M2	1.10	2.62*	1.88	1.10	2.08	1.60	4.76	10.00	7.32	0.00	4.76	2.33	-22.13**	-16.07**	-19.23**	-25.20**	-17.54**	-21.58**
L6 x M8	1.65	0.52	1.07	1.65	0.00	0.80	-14.29*	-15.00*	-14.63*	-18.18**	-19.05**	-18.60**	8.20*	-4.46	2.14	3.94	-6.14	-0.83
L6 x CIMMYT14	0.55	0.00	0.27	0.55	-0.52	0.00	9.52	10.00	9.76	4.55	4.76	4.65	-13.11**	-6.25	-9.83**	-16.54**	-7.89*	-12.45**
L7 x M2	0.55	0.52	0.54	0.55	0.00	0.27	9.52	10.00	9.76	4.55	4.76	4.65	1.64	-24.11**	-10.68**	-2.36	-25.44**	-13.28**
L7 x M8	1.10	3.66**	2.41	1.10	3.13*	2.14	-4.76	-5.00	-4.88	-9.09	-9.52	-9.30	9.84**	-16.96**	-2.99	5.51	-18.42**	-5.81
L7 x CIMMYT14	0.00	0.52	0.27	0.00	0.00	0.00	21.43**	10.00	15.85*	15.91**	4.76	10.47	9.84**	8.04*	8.97**	5.51	6.14	5.81
L8 x M2	1.65	1.05	1.34	1.65	0.52	1.07	4.76	5.00	4.88	0.00	0.00	0.00	0.00	5.36	2.56	-3.94	3.51	-0.41
L8 x M8	0.55	0.00	0.27	0.55	-0.52	0.00	9.52	10.00	9.76	4.55	4.76	4.65	-9.84**	-14.29**	-11.97**	-13.39**	-15.79**	-14.52**
L8 x CIMMYT14	-1.65	-1.05	-1.34	-1.65	-1.56	-1.60	4.76	5.00	4.88	0.00	0.00	0.00	-10.66**	-3.57	-7.26*	-14.17**	-5.26	-9.96**
L9 x M2	-2.20	-0.52	-1.34	-2.20	-1.04	-1.60	14.29*	-5.00	4.88	9.09	-9.52	0.00	7.38*	-6.25	0.85	3.15	-7.89*	-2.07
L9 x M8	-4.40**	-4.19**	-4.29**	-4.40**	-4.69**	-4.55**	-4.76	-5.00	-4.88	-9.09	-9.52	-9.30	3.28	11.61**	7.26*	-0.79	9.65**	4.15
L9 x CIMMYT14	-3.30*	-1.57	-2.41	-3.30*	-2.08	-2.67*	0.00	-5.00	-2.44	-4.55	-9.52	-6.98	9.02**	14.29**	11.54**	4.72	12.28**	8.30*
L10 x M2	1.65	0.52	1.07	1.65	0.00	0.80	14.29*	15.00*	14.63*	9.09	9.52	9.30	3.28	9.82**	6.41	-0.79	7.89*	3.32
L10 x M8	1.65	0.52	1.07	1.65	0.00	0.80	-9.52	-10.00	-9.76	-13.64*	-14.29*	-13.95*	9.84**	0.89	5.56	5.51	-0.88	2.49
L10 x CIMMYT14	-1.10	1.57	0.27	-1.10	1.04	0.00	4.76	5.00	4.88	0.00	0.00	0.00	3.28	8.04*	5.56	-0.79	6.14	2.49
L11 x M2	-2.75*	-2.09	-2.41	-2.75*	-2.60*	-2.67*	4.76	-5.00	0.00	0.00	-9.52	-4.65	-1.64	4.46	1.28	-5.51	2.63	-1.66
L11 x M8	2.20	0.52	1.34	2.20	0.00	1.07	14.29*	15.00*	14.63*	9.09	9.52	9.30	11.48**	11.61**	11.54**	7.09*	9.65**	8.30*
L11 x CIMMYT14	-2.75*	0.00	-1.34	-2.75*	-0.52	-1.60	4.76	5.00	4.88	0.00	0.00	0.00	-11.48**	-5.36	-8.55*	-14.96**	-7.02*	-11.20**
L12 x M2	0.55	0.52	0.54	0.55	0.00	0.27	-9.52	15.00*	2.44	-13.64*	9.52	-2.33	8.20*	16.96**	12.39**	3.94	14.91**	9.13**
L12 x M8	0.55	1.57	1.07	0.55	1.04	0.80	4.76	5.00	4.88	0.00	0.00	0.00	0.00	4.46	2.14	-3.94	2.63	-0.83
L12 x CIMMYT14	-1.65	-3.66**	-2.68*	-1.65	-4.17**	-2.94*	-4.76	0.00	-2.44	-9.09	-4.76	-6.98	-9.84**	-2.68	-6.41	-13.39**	-4.39	-9.13**

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

Table 7: Standard heterosis for No. of kernels row^{-1}, 100 kernel weight and grain yield (g) plant^{-1} relative to S.C. 128 and S.C. 30 k 8 under normal irrigation and drought stress as well as combined data**.**

Genotypes	100 kernel weight						Grain yield (g) plant^{-1}					
	Relative to S.C. 128			Relative to S.C. 30 k8			Relative to S.C. 128			Relative to S.C. 30 k8		
	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.	Normal	Stress	Comb.
L1 x M2	-13.99**	-11.11**	-12.59**	-18.00**	-10.45*	-14.44**	-24.35**	-13.40**	-19.61**	-25.56**	-15.21**	-21.07**
L1 x M8	-13.29**	-10.37*	-11.87**	-17.33**	-9.70*	-13.73**	-3.57**	-20.85**	-11.05**	-5.11**	-22.50**	-12.66**
L1 x CIMMYT14	18.88**	14.07**	16.55**	13.33**	14.93**	14.08**	20.62**	-2.13	10.77**	18.69**	-4.17*	8.77**
L2 x M2	-12.59**	-11.85**	-12.23**	-16.67**	-11.19**	-14.08**	-17.53**	-1.28	-10.50**	-18.85**	-3.33*	-12.12**
L2 x M8	9.79*	14.07**	11.87**	4.67	14.93**	9.51*	-10.55**	10.00**	-1.66	-11.98**	7.71**	-3.44*
L2 x CIMMYT14	13.29**	11.11**	12.23**	8.00*	11.94**	9.86*	-0.81	-17.02**	-7.83**	-2.40	-18.75**	-9.49**
L3 x M2	-12.59**	-10.37*	-11.51**	-16.67**	-9.70*	-13.38**	1.46	-6.60**	-2.03	-0.16	-8.54**	-3.80**
L3 x M8	-0.70	2.22	0.72	-5.33	2.99	-1.41	-9.58**	-14.26**	-11.60**	-11.02**	-16.04**	-13.20**
x CIMMYT14	7.69*	12.59**	10.07*	2.67	13.43**	7.75*	-27.92**	-29.79**	-28.73**	-29.07**	-31.25**	-30.02**
L4 x M2	-5.59	-1.48	-3.60	-10.00**	-0.75	-5.63	7.63**	-10.64**	-0.28	5.91**	-12.50**	-2.08
L4 x M8	9.79*	14.07**	11.87**	4.67	14.93**	9.51*	-6.66**	-15.32**	-10.41**	-8.15**	-17.08**	-12.03**
L4 x CIMMYT14	-7.69*	-4.44	-6.12	-12.00**	-3.73	-8.10*	1.46	-27.66**	-11.14**	-0.16	-29.17**	-12.75**
L5 x M2	16.08**	16.30**	16.19**	10.67**	17.16**	13.73**	19.16**	30.43**	24.03**	17.25**	27.71**	21.79**
L5 x M8	9.79*	3.70	6.83	4.67	4.48	4.58	5.36**	-20.43**	-5.80**	3.67**	-22.08**	-7.50**
L5 x CIMMYT14	4.90	7.41	6.12	0.00	8.21*	3.87	-22.73**	-0.21	-12.98**	-23.96**	-2.29	-14.56**
L6 x M2	-13.29**	-10.37*	-11.87**	-17.33**	-9.70*	-13.73**	-0.65	-28.72**	-12.80**	-2.24	-30.21**	-14.38**
L6 x M8	11.19**	5.93	8.63*	6.00	6.72	6.34	2.76*	-2.55	0.46	1.12	-4.58**	-1.36
L6 x CIMMYT14	14.69**	16.30**	15.47**	9.33*	17.16**	13.03**	-31.82**	-13.19**	-23.76**	-32.91**	-15.00**	-25.14**
L7 x M2	8.39*	11.11**	9.71*	3.33	11.94**	7.39	-13.15**	12.34**	-2.12	-14.54**	10.00**	-3.89**
L7 x M8	7.69*	11.85**	9.71*	2.67	12.69**	7.39	-20.13**	-18.09**	-19.24**	-21.41**	-19.79**	-20.71**
L7 x CIMMYT14	20.28**	5.93	13.31**	14.67**	6.72	10.92**	26.14**	6.38**	17.59**	24.12**	4.17*	15.46**
L8 x M2	9.79*	14.81**	12.23**	4.67	15.67**	9.86*	4.71**	20.43**	11.51**	3.04*	17.92**	9.49**
L8 x M8	10.49**	14.81**	12.59**	5.33	15.67**	10.21*	15.10**	-32.55**	-5.52**	13.26**	-33.96**	-7.23**
L8 x CIMMYT14	14.69**	19.26**	16.91**	9.33*	20.15**	14.44**	-2.92*	-10.64**	-6.26**	-4.47**	-12.50**	-7.96**
L9 x M2	17.48**	17.78**	17.63**	12.00**	18.66**	15.14**	19.16**	-31.49**	-2.76	17.25**	-32.92**	-4.52**
L9 x M8	11.89**	5.93	8.99*	6.67	6.72	6.69	-3.25*	-34.04**	-16.57**	-4.79**	-35.42**	-18.08**
L9 x CIMMYT14	12.59**	6.67	9.71*	7.33*	7.46	7.39	-5.68**	-30.21**	-16.30**	-7.19**	-31.67**	-17.81**
L10 x M2	-5.59	-1.48	-3.60	-10.00**	-0.75	-5.63	-13.64**	12.77**	-2.21	-15.02**	10.42**	-3.98**
L10 x M8	12.59**	16.30**	14.39**	7.33*	17.16**	11.97**	17.37**	-21.91**	0.37	15.50**	-23.54**	-1.45
L10 x CIMMYT14	0.00	5.19	2.52	-4.67	5.97	0.35	-36.04**	-36.17**	-36.10**	-37.06**	-37.50**	-37.25**
L11 x M2	1.40	2.96	2.16	-3.33	3.73	0.00	-12.82**	-19.79**	-15.84**	-14.22**	-21.46**	-17.36**
L11 x M8	19.58**	25.19**	22.30**	14.00**	26.12**	19.72**	22.40**	-1.06	12.25**	20.45**	-3.13	10.22**
L11 x CIMMYT14	-13.29**	-18.52**	-15.83**	-17.33**	-17.91**	-17.61**	-38.15**	-28.51**	-33.98**	-39.14**	-30.00**	-35.17**
L12 x M2	18.18**	2.22	10.43*	12.67**	2.99	8.10*	19.64**	-3.19	9.76**	17.73**	-5.21**	7.78**
L12 x M8	4.20	7.41	5.76	-0.67	8.21*	3.52	-38.31**	-34.04**	-36.46**	-39.30**	-35.42**	-37.61**
L2 x CIMMYT14	21.68**	6.67	14.39**	16.00**	7.46	11.97**	-39.12**	-21.06**	-31.31**	-40.10**	-22.71**	-32.55**

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

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التفوق المحصولى والقدرة على التآلف لبعض الهجن الجديدة من الذرة الشامية تحت ظروف الرى العادى والإجهاد الرطوبى

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استخدمت فى هذه الدراسة طريقة السلالة × الكشاف لتقدير القدرة العامة والخاصة على التآلف لبعض الصفات الهامة فى الذرة الشامية وحيث تم تهجسن اثنتى عشر سلالة نقية من الذرة الشامية مع ثلاثة كشافات، وتم تقييم الهجن القمية الناتجة (ثلاثون هجينا) مع هجينين للمقارنة (هـف 128، هـف 30 ك 8) فى تجربتين تحت ظروف الرى العادى كل 12 يوم وتحت ظروف الإجهاد الرطوبى حيث كان يتم الرى كل 21 يوم. واستخدم فى كل تجربة تصميم القطاعات الكاملة العشوائية مع ثلاثة مكررات وتم تقدير القدة العامة والخاصة على التألف وقوة الهجين لعدد الأيام حتى خروج 50% من الحريرة، عدد صفوف الكوز، عدد حبوب الصف، وزن 100 حبة ومحصول الحبوب للنبات. واظهرت النتائج ان الإجهاد الرطوبة قد أثر معنويا على جميع الصفات تحت الدراسة وان الهجين القمى L9 x M2 قد أعطى افضل النتائج لصفة عدد الأيام حتى خروج 50% من الحريرة تحت ظروف الرى العادى والجفاف بينما اعطى الهجين L7 x CIMMYT14 أفضل النتائج لصفة محصول الحبوب تحت ظروف الرى العادى والتحليل التجميعى للبيانات. وكان تباين القدرة الخاصة على التآلف اكبر منه للقدرة العامة على التآلف مما يعنى أهمية التباين الوراثى غير المضيف فى توارث جميع الصفات تحت الدراسة. وأعطت السلالتين L5, L8 افضل النتائج لتأثيرات القدرة العامة على التآلف لصفحة محصول الحبوب للنبات وبعض الصفات الأخرى. وأمكن الحصول على أفضل تأثيرات للقدرة الخاصة على التآلف فى الهجين L9 x M8 لصفة عدد الأيام حتى خروج 50% من الحريرة والهجينين L7 x CIMMYT 14, L11 x M8 لصفة محصول الحبوب للنيات وبعض مكوناته. وافضل قيمة لقوة الهجين القياسية نسبة الى كلا الصنفين المستخديمن (هـف 128، هـف 30 ك8) امكن الحصول عليها فى الهجين L9 x M8 لصفة عدد الأيام حتى خروج 50% من الحريرة، أما افضل قيم لقوة الهجين بالنسبة لصفة محصول الحبوب للنبات فقد أمكن الحصول عليها فى الهجينين L5 x M2 (تحت ظروف الجفاف والتحليل التجميعى) ، L7 x CIMMYT14 (تحت ظروف الرى العادى).