Combining ability of some prolific and non-prolific maize inbred lines for grain yield and other related traits

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ABSTRACT

This study aimed to assess the general and specific combining ability effects of parental lines and its hybrids for grain yield and some related traits. Therefore, twelve inbred lines of maize (six inbreds were prolific and other six inbreds were non-prolific) were top-crossed with two inbred line testers at Sakha Agriculture Research Station during 2007 summer season. The resultant 24 F_1's along with two check white single crosses 10 and 128 were evaluated at Sakha and Mallawy Research Stations in 2008 summer season. Data were taken for traits of days to mid-silk (DS), plant height (PH), ear height (EH), ear position % (EP%), number of ears/100 plants (E/100PL), grain yield ard/fed (GY), ear length (EL), ear diameter (ED), rows/ear (R/E), kernels/row (K/R) and percentage of resistance to late wilt disease (RLW%).

Significant differences were observed among lines (L), testers (T) and L × T interaction for all the studied traits at both locations except due to testers for EL, ED and R/E at Mallawy and L × T interaction of EL, ED, R/E and K/R at Sakha. Non-additive gene action played an important role in the inheritance of DS, E/100PL, RLW%, GY, ED and K/R at Sakha and all traits at Mallawy. Meanwhile, the other studied traits controlled mainly by the additive gene action at Sakha location. The best combiner inbred lines at both locations were Sk5008 for earliness, short plant and low ear placement and lines Sk5004 and Sk5012 for prolificacy as well as Sk5009 and Sk5016 for ear length and kernel/row and Sk5010 for GY and R/E. The best combiner tester was inbred line Sd7 for grain yield and resistance to late wilt and inbred line Sk5 for earliness and ear position at both locations. Best top-crosses for desirable SCA effects were Sk5009 × Sk5 for yielding ability, earliness and prolific followed by Sk5010 × Sd7 and Sk5016 × Sd7 for yielding ability at both locations.

Grain yield productivity character for nine top-crosses i.e. Sk5010 × Sd7, Sk5016 × Sd7, Sk5011 × Sd7, Sk5003 × Sd7, Sk5012 × Sd7, Sk5002 × Sd7, Sk5014 × Sd7, Sk5004 × Sd7 and Sk5013 × Sd7 at Sakha and SC Sk5010 × Sd7 at Mallawy were significantly better than the best check SC10. At the same time these top-crosses were characterized by earliness, best ear position, prolific and resistance to late wilt disease. However, these promising single crosses will need more extensive and wide experiments before their releasing it as stable high yield ability with important agronomic traits.

INTRODUCTION

Maize is an important cereal crop of the world. Its cultivation extends over a wide range of geographical and environmental conditions. It is the stable food of people in developing countries in Asia, Latin America and Africa.

The estimates of genetic components of variance help to predict the expected genetic gain from selection by allowing choice among breeding methods for optimizing management of available genetic variability. Among a large array of biometrical procedure for relative estimation of genetic component, line x tester is an efficient procedures as it allows for inclusion of a large number of lines and provides reliable estimates of genetic components, estimates of combining ability and gene action governing a complex trait. The homozygous inbred line as tester has been widely used by several breeders among of them (Darrah 1985, Horner *et al.*1989 and Mosa *et al.* 2009) and it would be suitable for rapid getting new single crosses.

Numerous investigators found that the additive genetic effects played an effective role in the inheritance of grain yield (Kadlubiec *et al.* 2000 and Motawei and Ibrahim 2005) and late wilt resistance (Soliman and Sadek 1999, Mosa *et al.* 2004 and Mosa and Motawei 2005). However, other researchers suggested that the magnitude of non-additive genetic effects represented the major role in the inheritance of grain yield (Kara 2001, Ashish and Singh 2002, Dodiya and Joshi 2002, Motawei *et al.* 2005 and Motawei 2006); days to 50% silking (Gul *et al.* 2000, Dubey *et al.* 2001, El-Shenawy 2005 and Motawei 2006); plant height (Turgut *et al.* 1995, San *et al.* 2001 and Mosa 2003) and late wilt resistance (Shehata 1976, El-Itriby *et al.* 1984, Amer *et al.* 1999 and Mosa *et al.* 2004).

The present investigation was undertaken to characterize new white maize inbred lines in terms of their combining ability and the gene effects for various quantitative traits and to identify promising hybrids for yielding ability with suitable agronomic characters and resistance to late wilt disease.

MATERIALS AND METHODS

The present investigation materials were 12 white inbred lines i.e. Sk5002, Sk5003, Sk5004, Sk5010, Sk5011 and Sk5012 as prolific inbreds and Sk5008, Sk5009, Sk5013, Sk5014, Sk5015 and Sk5016 as non-prolific inbreds. These inbred lines were developed at Sakha Agricultural Research Station throughout selfed hybridization in five different genetic sources with selection between and within progeny lines of families for resistance to late wilt disease and good plant type in the generation field, starting from 2002 to 2006. The 12 inbred lines were top-crossed with two elite inbred lines as testers Sk5 and Sd7 in

a line x tester design in 2007 growing season. The resulting 24 top-crosses and two commercial check hybrids SC10 and SC128 were evaluated in a randomized complete block design with four replications at Sakha and Mallawy Agricultural Research Stations during 2008 growing season. Each genotype in each replication was represented by one row of 6m length with inter and intra rows or hills spacing of 80 and 25cm, respectively. All culture practices were applied as recommended in the proper time at both locations. Data were recorded on 11 quantitative traits including number of days to mid-silk (DS), plant height (PH) in cm, ear height (EH) in cm, ear position % (EP%), number of ears/100 plants (E/100pL), grain yield ard/fed (GY) adjusted on the basis of 15.5% grain moisture content, ear length (EL) in cm, ear diameter (ED) in cm, number of rows/ear (R/E), number of kernels/row (K/R) and percentage of resistance to late wilt disease (RLW%).

Combined analysis of variance was not proven because the homogeneity of error mean squares among the two locations was significant for some traits; therefore analysis of variance was carried out of the all studied traits for each location according to Steel and Torrie (1980). When mean squares among top-crosses were found significantly different, line × tester analysis as outlined by Singh and Choudhary (1979) was applied to estimate general and specific combining ability effects using Agrobase/4 version 1.3b.

RESULTS AND DISCUSSION

Analysis of variance for 11 studied traits at Sakha and Mallawy locations are found in Table (1). Highly significant differences were detected for genotypes and their partitions crosses (C), checks (CH) and C vs. CH of all studied traits except due to CH for EH, EP% and E/100pL at Mallawy, GY and RLW% at Sakha and ED, R/E and K/R at both locations, due to C vs. CH for SD and K/R at Sakha, E/100PL and EL at Mallawy and EP, ED, R/E and RLW% at the two locations.

Mean performance of 24 top-crosses and two checks for agronomic traits (DS, PH, EH, EP% and E/100PL) and RLW% at Sakha and Mallawy locations are shown in Table (2). Days to mid-silk ranged from 58.3 (Sk5009 × Sk5) to 62.5 (Sk5009 × Sd7) with an average of 60.2 days at Sakha and from 58.3 (Sk5008 × Sk5) to 65.3 (Sk5012 × Sd7) with an average of 61.5 days at Mallawy. The top-crosses Sk5008 × Sk5, Sk5009 × Sk5, Sk5013 × Sk5, Sk5013 × Sd7 and Sk5014 × Sk5 were significantly earlier than the check SC10 and not significant differences with the earlier check SC128 at both locations. Plant height ranged from 275.3 cm (Sk5009 × Sk5) to 346.0 cm (Sk5010 × Sd7) at Sakha and from 224.0 cm (SK5008 × Sk5) to 257.8 (Sk5014 × Sd7) at Mallawy. Only one top-cross Sk5008 × Sk5 decreased significantly in plant height than the two checks SC10 and

Table 1: Analysis of variance for 11 studied traits at Sakha and Mallawy Agricultural Research Stations.

Traits	S.O.V. / d.f. / Location	Replication	Entries	Crosses (C)	Check (CH)	C vs. CH	error
	d.f.	3	25	23	1	1	75
Days to mid-silk	Sk	2.282	4.34**	4.15**	12.5**	0.55	1.30
	Mal	15.897**	12.84**	12.097**	36.13**	6.64**	0.951
Plant height	Sk	632.45**	1509.71**	1477.99**	3403.13**	345.85*	63.38
	Mal	77.01	358.23**	336.11**	264.5*	960.72**	47.39
Ear height	Sk	405.10**	1465.32**	1356.24**	5050.13**	389.35**	42.87
	Mal	27.343	396.57**	413.66**	112.5	287.57*	61.57
Ear position%	Sk	15.45**	39.16**	35.66**	152.45**	6.37	3.56
	Mal	1.402	23.32**	25.32**	0.52	0.12	4.79
Ears/100plants	Sk	20.06	2720.4**	2789.9**	800.0**	3082.32**	29.08
	Mal	71.67*	195.33**	206.78**	35.67	91.64	23.69
Late wilt resistance%	Sk	0.154	3.936**	4.261**	0.000	0.447	0.154
	Mal	0.031	4.75**	5.038**	2.88**	0.226	0.18
Grain yield	Sk	22.99**	158.55**	170.99**	1.775	29.21*	4.39
	Mal	47.46**	49.533**	48.01**	21.098*	112.99**	4.85
Ear length	Sk	1.02	3.293**	3.069**	3.92**	7.82**	0.555
	Mal	1.36	4.473**	4.61**	4.805**	0.99	0.602
Ear diameter	Sk	0.04	0.119**	0.129**	0.005	0.003	0.023
	Mal	0.122	0.269**	0.291**	0.020	0.012	0.062
No. of rows/ear	Sk	0.766	2.729**	2.86**	1.445	1.00	0.445
	Mal	1.013*	1.44**	1.551**	0.180	0.147	0.355
No. of kernels/row	Sk	3.08	22.92**	23.85**	9.68	14.77	3.85
	Mal	13.99	37.93**	38.32**	12.01	54.88**	5.73

*, ** Significant differences at 0.05 and 0.01 levels of probability, respectively.

SC128 at both locations. EH ranged from 137.5cm for top-cross Sk5008 × Sk5 to 202.0 cm for top-cross Sk5016 × Sd7 with an average of 167.8cm at Sakha and from 117.0cm (Sk5004 × Sk5) to 153.8cm (Sk5016 × Sd7) with an average of 135.5cm at Mallawy. Top-cross Sk5008 × Sk5 decreased significantly in ear height than the two checks at both locations. The best top-crosses for EP% were Sk5003 × Sk5, Sk5004 × Sk5, Sk5008 × SK5 and Sk5010 × Sk5 at both locations. No. of ears/100 plant ranged from 98.9 (Sk5013 × Sk5 and Sk5016 × Sk5) to 185.7 (Sk5012 × Sd7) with an average of

Table 2: Mean performance of 24 top-crosses and two checks for agronomic traits (DS, PH, EH, EP% and E/100PL) and RLW% at Sakha and Mallawy locations.

Cross	Days to mid-silk		Plant height (cm)		Ear height (cm)		Ear position%		Number of Ear/100plant.		Resistance to late wilt	
	Sk	Mal	Sk	Mal	Sk	Mal	Sk	Mal	Sk	Mal	Sk	Mal
Sk5002 × Sk5	60.0	60.8	288.5	238.8	156.3	131.0	54.2	54.8	109.5	100.0	100	100
Sk5002 × Sd7	61.0	63.0	311.3	251.3	174.5	142.0	56.1	56.4	158.0	106.4	100	100
Sk5003 × Sk5	60.5	62.3	282.5	234.5	147.5	123.8	52.2	52.8	116.7	98.8	100	100
Sk5003 × Sd7	60.3	62.0	309.0	244.0	173.8	131.0	56.2	53.7	165.8	105.5	100	98.5
Sk5004 × Sk5	60.5	61.0	298.5	227.5	158.0	117.0	52.9	51.4	123.2	105.0	100	99.8
Sk5004 × Sd7	60.5	62.5	317.3	248.3	183.3	139.3	57.8	56.1	178.8	118.8	100	99.5
Sk5008 × Sk5	58.5	58.3	277.3	224.0	137.5	121.0	49.6	54.0	103.0	98.9	100	100
Sk5008 × Sd7	59.5	62.3	317.3	247.5	166.0	136.0	52.4	54.9	112.0	100.3	100	98.9
Sk5009 × Sk5	58.3	60.0	275.3	245.0	140.0	136.0	51.0	55.5	108.2	104.0	100	100
Sk5009 × Sd7	62.5	63.8	305.8	251.0	158.0	138.3	51.7	55.1	123.0	100.0	100	100
Sk5010 × Sk5	60.3	61.0	300.3	224.5	159.8	123.3	53.2	54.9	120.0	100.0	100	100
Sk5010 × Sd7	61.3	64.3	346.0	246.3	199.8	145.5	57.8	59.1	167.8	122.0	100	98.9
Sk5011 × Sk5	61.0	59.5	292.0	237.0	156.3	122.5	53.5	51.7	115.6	100.1	100	100
Sk5011 × Sd7	61.3	63.0	333.0	248.0	193.3	149.3	58.1	60.2	171.2	114.0	100	100
Sk5012 × Sk5	60.3	61.5	298.8	242.5	165.5	135.5	55.4	55.8	128.7	105.0	100	98.9
Sk5012 × Sd7	61.0	65.3	329.5	248.0	192.0	149.3	58.3	60.2	185.7	126.0	100	100
Sk5013 × Sk5	58.5	58.5	275.5	239.8	154.3	126.0	56.0	52.6	98.9	95.5	100	100
Sk5013 × Sd7	59.5	60.0	319.0	242.5	192.5	134.8	60.3	55.6	126.3	102.1	100	100
Sk5014 × Sk5	58.8	60.0	294.0	242.8	152.3	136.8	51.8	56.3	113.4	102.2	100	100
Sk5014 × Sd7	60.8	62.0	313.3	257.8	175.3	151.5	55.9	58.8	143.9	109.3	100	98.9
Sk5015 × Sk5	61.0	60.5	287.8	230.8	150.8	130.0	52.4	56.3	111.3	100.0	95	94.8
Sk5015 × Sd7	59.8	63.0	305.5	245.5	161.3	139.5	52.8	56.8	122.8	102.3	99	100
Sk5016 × Sk5	60.0	61.0	298.8	236.0	167.3	127.5	56.0	54.0	98.9	96.5	100	98.8
Sk5016 × Sd7	60.8	62.5	333.0	257.3	202.0	153.8	60.7	59.8	124.3	106.0	100	100
CheckSC10	61.5	62.8	332.0	259.3	199.8	145.0	60.1	56.0	120.0	103.1	100	100
CheckSC128	59.0	58.5	290.8	247.8	149.5	137.5	51.4	55.4	100.0	98.9	100	98.8
Mean of single crosses	60.2	61.5	305.1	242.9	167.8	135.5	54.9	55.7	128.7	104.3	99.8	99.4
L.S.D at 0.05 between two	1.6	1.4	11.1	9.6	9.2	10.9	2.6	3.1	7.6	6.8	0.55	0.59
C.V%	1.9	1.6	2.6	2.8	3.9	5.8	3.4	3.9	4.2	4.7	0.4	1.0

128.7 ears/100 plant at Sakha. While, at Mallawy, it ranged from 95.5 (Sk5013 × Sk5) to 126.0 (Sk5012 × Sd7) with an average of 104.3 ears/100 plant. Four top-crosses (Sk5004 × Sd7, Sk5010 × Sd7,

Sk5011 × Sd7 and Sk5012 × Sd7) out of 24 top-crosses increased significantly for E/100PL than the best check of this trait (SC10) at both locations. All top-crosses exhibited high percentage of resistance to late wilt disease at both locations.

Mean performance of 24 top-crosses and the two checks for grain yield and yield component traits (EL, ED, R/E and K/R) at Sakha and Mallawy locations are shown in Table (3). Grain yield ranged from 31.9 ard/fed for Sk5011 × Sk5 to 52.08 ard/fed for Sk5010 × Sk5 with an average of 39.86 ard/fed at Sakha location. While, at Mallawy it ranged from 24.9 ard/fed for Sk5016 × Sk5 to 40.15 ard/fed for Sk5010 × Sd7 with an average of 30.75 ard/fed. Nine top-crosses i.e. Sk5010 × Sd7 (52.08 ard/fed), Sk5016 × Sd7 (51.94 ard/fed), Sk5011 × Sd7 (48.57 ard/fed), Sk5003 × Sd7 (48.44 ard/fed), Sk5012 × Sd7 (47.69 ard/fed), Sk5002 × Sd7 (46.54 ard/fed), Sk5014 × Sd7 (46.28 ard/fed), Sk5004 × Sd7 (45.82 ard/fed) and Sk5013 × Sd7 (42.53 ard/fed) were significantly outyielded than the best check SC10 (38.5 ard/fed) at Sakha location. The main reason of increasing grain yield of these nine top-crosses than check due to it had the highest values for No. of ears/100 plant (prolific hybrids) and ranged from 124.3 to 185.7%. Generally, the above 9 top-crosses characterized also by earliness, best ear position and high no. of ears/100 plant beside resistance to late wilt disease showed as promising single crosses which would be fruitful and effective in maize breeding program especially at north delta condition. Meanwhile, at Mallawy and relative to the best check SC10 only one top-cross Sk5010 × Sd7 (40.15 ard/fed) increased significantly and Sk5016 x Sd7 (36.05 ard/fed) exceeded but not significant with it.

With respect to EL trait, it ranged from 19.5cm (Sk5004 × Sk5) to 22.6cm (Sk5009 × Sd7) with an average of 21.3cm at Sakha and from 16.5cm (Sk5015 × Sk5) to 20.9cm (Sk5013 × Sd7) with an average of 19.1cm at Mallawy location. On the other side ED trait ranged from 4.8 cm (Sk5004 × Sd7) to 5.5cm (Sk5015 × Sk5) with an average of 5.1cm and from 4.6 cm (Sk5013 × Sk5) to 5.6cm (Sk5013 × Sk5) with an average of 5.1cm at Sakha and Mallawy locations, respectively. Rows/ear trait ranged from 12.6 for Sk5009 × Sd7 to 15.9 for Sk5010 × Sk5 with an average of 13.9 at Sakha and from 12.6 for Sk5004 × Sk5 to 15.2 for Sk5011 × Sk5 with an average of 13.8 at Mallawy. Generally most of the top-crosses did not differ significantly from the two checks for EL, ED and R/E at both locations. In relation to K/R trait, it ranged from 39.7 for Sk5012 × Sd7 to 48.1 for Sk5009 × Sd7 with an average of 44.0 and from 38.8 for Sk5004 × Sd7 to 48.9 for Sk5009 × Sk5 with an average of 43 9 at Sakha and Mallawy locations, respectively.

Table3: Mean performance of 24 top-crosses and two checks for grain yield and yield components traits (EL, ED, R/E and K/R) at Sakha and Mallawy locations.

Cross	Grain yield (ard/fed)		Ear length (cm)		Ear diameter (cm)		Number of rows/ear		Number of Kernel/rows	
	Sk	Mal	Sk	Mal	Sk	Mal	Sk	Mal	Sk	Mal
Sk5002 × Sk5	33.46	29.11	20.4	19.2	5.2	4.9	14.1	13.5	44.6	41.3
Sk5002 × Sd7	46.54	34.76	21.1	19.6	5.1	5.2	13.5	14.0	46.1	47.9
Sk5003 × Sk5	36.23	26.16	21.1	19.8	5.1	4.7	13.4	13.8	43.2	43.0
Sk5003 × Sd7	48.44	28.69	21.6	18.7	5.0	5.0	13.0	12.8	46.1	45.5
Sk5004 × Sk5	35.44	31.80	19.5	18.1	5.0	4.7	13.4	12.6	41.7	41.2
Sk5004 × Sd7	45.82	31.30	19.9	17.0	4.8	5.0	12.9	13.6	40.5	38.8
Sk5008 × Sk5	36.17	27.61	21.4	18.1	5.1	5.3	13.0	14.1	46.7	44.9
Sk5008 × Sd7	35.28	27.33	21.2	19.3	5.2	5.4	13.5	14.0	45.2	45.6
Sk5009 × Sk5	36.77	31.09	22.1	19.9	5.3	5.6	13.4	14.6	44.0	48.9
Sk5009 × Sd7	36.44	29.33	22.6	19.4	5.1	5.2	12.6	13.8	48.1	48.6
Sk5010 × Sk5	37.72	30.88	20.6	18.8	5.1	5.3	15.9	14.1	44.7	39.9
Sk5010 × Sd7	52.08	40.15	21.7	19.8	4.9	5.3	14.9	14.7	45.2	48.3
Sk5011 × Sk5	31.90	28.74	20.0	19.6	5.0	5.6	14.9	15.2	40.4	43.8
Sk5011 × Sd7	48.57	31.73	21.9	18.6	5.0	5.0	14.5	14.2	41.0	43.8
Sk5012 × Sk5	33.67	30.16	20.2	18.9	5.1	5.0	14.1	13.7	40.7	41.1
Sk5012 × Sd7	47.69	31.99	21.0	19.4	4.8	4.9	13.6	13.4	39.7	43.2
Sk5013 × Sk5	34.02	27.49	21.3	19.0	5.3	4.6	14.8	12.8	41.9	41.8
Sk5013 × Sd7	42.53	28.36	21.9	20.9	5.3	5.2	13.9	14.1	45.6	42.6
Sk5014 × Sk5	36.25	32.19	21.2	20.9	5.3	5.3	14.9	14.2	41.9	45.2
Sk5014 × Sd7	46.28	34.35	22.3	19.9	5.3	5.1	14.1	14.1	43.6	43.2
Sk5015 × Sk5	33.48	26.27	20.1	16.5	5.5	5.1	15.2	14.6	44.6	39.0
Sk5015 × Sd7	38.72	30.43	21.1	17.7	5.2	4.7	14.4	13.1	44.8	39.2
Sk5016 × Sk5	34.94	24.90	22.1	20.0	5.4	5.2	13.6	14.0	45.9	45.2
Sk5015 × Sd7	51.94	36.05	22.5	19.5	5.2	5.1	13.3	13.7	47.8	47.2
Check SC10	38.50	35.99	21.5	18.7	5.2	5.1	13.2	13.3	46.4	43.7
Check SC128	37.56	32.74	22.9	20.3	5.2	5	14.0	13.8	44.2	42.6
Mean of single crosses	39.86	30.75	21.3	19.1	5.1	5.1	13.9	13.8	44.0	43.9
L.S.D at 0.05 between two	2.93	3.1	1.0	1.1	0.21	0.35	0.93	0.83	2.70	3.40
C.V%	5.3	7.2	3.5	4.1	3.0	6.9	4.8	4.3	4.5	5.5

Moreover, two top crosses (Sk5009 × Sd7 and Sk5016 × Sd7) at both locations exhibited the highest estimates for this trait. As the

general, the two top crosses Sk5010 × Sd7 and Sk5016 × Sk7 gave the highest values for grain yield beside their best characteristic in most studied traits at both locations, indicating that these crosses would be fruitful and effective in maize breeding program.

Line × tester analysis of 24 top-crosses for all the studied traits were presented in Table (4). Significant to highly significant differences were observed among lines (L), testers (T) and L × T interaction for all the studied traits except due to testers for EL, ED and R/E at Mallawy and due to L × T for EP%, EL, ED, R/E and K/R at Sakha.

Table 4: Line × Tester analysis of 24 top-crosses for 11 studied traits at Sakha and Mallawy locations.

Traits	S.O.V.	Line (L)	Tester (T)	L × T	Error
	d.f / Location	11	1	11	75
Days to mid-silk	Sk	3.428**	18.38**	3.58**	1.30
	Mal	9.10**	142.59**	3.23**	0.951
Plant height	Sk	804.48**	22909.26**	203.19**	63.38
	Mal	195.25**	4496.3**	98.97*	47.39
Ear height	Sk	1058.12**	17739.48**	164.94**	42.87
	Mal	251.87**	8385.001**	123.51*	61.57
Ear position%	Sk	45.7**	263.28**	4.96	3.56
	Mal	19.59**	221.04**	13.25**	4.79
Ears/100plants	Sk	2337.9**	31096.8**	668.59**	29.08
	Mal	203.49**	1556.87**	86.98**	23.69
Late wilt resistance%	Sk	6.00**	2.67**	2.67**	0.154
	Mal	4.01**	1.37**	6.4**	0.180
Grain yield	Sk	66.78**	2411.05**	71.55**	4.39
	Mal	48.23**	241.20**	30.22**	4.85
Ear length	Sk	4.53**	13.5**	0.655	0.555
	Mal	7.25**	0.15	2.36**	0.602
Ear diameter	Sk	0.191**	0.427**	0.039	0.023
	Mal	0.363**	0.010	0.245*	0.062
No. of rows/ear	Sk	5.02**	7.15**	0.310	0.445
	Mal	1.727**	0.602	1.461**	0.355
No. of kernels/row	Sk	40.25**	30.15**	6.88	3.85
	Mal	54.9**	55 97**	20.13**	5.73

*, ** Significant differences at 0.05 and 0.01 levels of probability, respectively.

Differences between lines indicated that the inbred lines differed from each other in their respective top crosses. Meanwhile, the significance of variance among testers indicates a wide rang of variability among the two testers. On the other hand, significant of L × T interaction suggesting that the inbred lines might differently perform

in top-crosses, depending on type of used tester. These results are in agreement with those previously obtained by Mosa *et al.* (2004), Motawei (2005), Motawei and Ibrahim (2005), Motawei (2006), Riboniesa and Magulama (2008) and Mosa *et al.* (2009).

Estimates of general combining ability effects for 12 inbred lines and two testers of 11 studied traits are found in Table (5). Inbred lines Sk5008 and Sk5013 were the best combiners for earliness at both locations. Inbred lines Sk5003, Sk5009, Sk5013 and Sk5015 at Sakha, inbred line Sk5010 at Mallawy and Sk5008 at both locations exhibited good general combiners toward short plant. Moreover, inbred lines Sk5003 and Sk5008 at both locations, Sk5009 and Sk5015 at Sakha and Sk5004 at Mallawy had negative estimates of GCA effects toward low ear placement. Inbred lines Sk5008, Sk5009 and Sk5015 at Sakha and Sk5003, Sk5004 and Sk5013 at Mallawy gave negative and significant estimates of gca effects toward best ear position. In addition, inbred lines i.e. Sk5003, Sk5010 and Sk5011 at Sakha and Sk5004 and Sk5012 at both locations had favorable alleles for exceeding No. of ears/100PL. On the other hand, four inbred lines (Sk5002, SK5009, Sk5011 and Sk5013) at Mallawy were identified as good general combiners for resistance to late wilt disease. In relation to estimates of GCA effects for GY and its component traits showed that the best combiner inbred lines were Sk5003 and Sk5016 at Sakha, Sk5014 at Mallawy and Sk5010 at both locations for GY. Inbred lines Sk5009, Sk5014 and SK5016 at both locations beside Sk5013 at Mallawy for EL. Inbred lines Sk5012, Sk5013, Sk5014, Sk5015 and Sk5016 at Sakha and Sk5008, Sk5009, Sk5010 and Sk5011 at Mallawy for ED; Sk5014 and Sk5015 at Sakha and Sk5010 and Sk5011 at both locations for R/E and Sk5002 and Sk5008 at Sakha and Sk5009 and Sk5016 at both locations for K/R exhibited desirable estimates of GCA effects. From these results it could be concluded that the best combiners over all the 12 inbred lines at both locations were Sk5008 for earliness, short plant and low ear placement, Sk5009 and Sk5016 for ear length and kernel/row, Sk5010 for GY, E/100PL and R/E. These inbred lines could be utilized in making hybrids for yielding ability and best plant type with prolific plants.

The general combining ability effects of the two testers (Table5) demonstrated that the inbred line SK5 as tester was the best general combiner for DS, PH, EH and EP% at both location and for ED and R/E at Sakha location. While, the inbred line Sd7 as tester was identified the best general combiner for E/100PL, GY, K/R and RLW% at both locations and for EL at Sakha. The homozygous inbred line as tester has been widely used by several breeders among of them (Darrah 1985, Horner *et al.*1989 and Mosa *et al.* 2009) and it would be suitable for rapid getting new S.C.

Table 5: General combining ability effects for 12 inbred lines and 2 testers for 11 studied traits at Sakha and Mallawy locations.

Trait / Inbred line		Sk 5002	Sk 5003	Sk 5004	Sk 5008	Sk 5009	Sk 5010	Sk 5011	Sk 5012	Sk 5013	Sk 5014	Sk 5015	Sk 5016	Tester Sk5	Tester Sd7	L.S.D gca L at 0.05	L.S.D gca T at 0.05
DS	Sk	0.27	0.15	0.27	-1.23*	0.15	0.52	0.90*	0.40	-1.23*	-0.48	0.15	0.15	-0.44*	0.44*	0.799	0.33
	Mal	0.302	0.552	0.177	1.323*	0.302	1.052*	-0.323	1.002*	2.323*	0.573	0.177	0.177	1.219*	1.219*	0.68	0.28
PH	Sk	-4.65	-9.78*	3.34	-7.28*	14.83*	18.60*	7.97*	9.59*	-7.28*	-0.91	-7.91*	11.34*	15.45*	15.45*	5.57	2.28
	Mal	2.906	-3.844	-4.219	-6.34*	5.91*	-6.72*	0.41	3.16	-0.969	8.16*	-3.97	4.53	6.84*	6.84*	4.82	1.97
EH	Sk	-1.99	-6.74*	3.26	15.61*	18.36*	12.39*	7.36*	11.39*	6.81*	-3.61	11.36*	17.36*	13.59*	13.59*	4.58	1.87
	Mal	1.49	-7.63*	-6.89*	-4.51*	2.11	-0.64	0.86	7.36*	-4.64	9.11*	-0.36	5.61*	7.49*	7.49*	5.49	2.24
EP	Sk	0.28	-0.62	0.52	-3.98*	-3.52*	0.65	0.97	2.03*	3.32*	-0.99	-2.25*	3.48*	-1.66*	1.66*	1.32	0.54
	Mal	0.07	2.46*	-1.93*	1.25	-0.43	1.29	0.25	2.30*	-1.64*	1.07*	0.88	1.21	-1.52	1.52	1.53	0.63
E/100pL	Sk	3.46	10.98*	20.68*	22.79*	14.69*	13.61*	13.14*	26.88*	17.69*	-1.66	13.24*	18.68*	17.99*	17.99*	3.78	1.54
	Mal	-1.34	-3.35	7.36*	-4.98*	-2.54	1.46	2.49	11.06*	5.70*	1.24	-3.40	-3.19	4.03*	4.03*	3.41	1.39
RLW%	Sk	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	-2.75*	0.25	-0.17*	0.17*	0.27	0.11
	Mal	0.56*	-0.21	-0.801	0.056	0.56*	-0.801	0.56*	-0.801	0.056	0.024	-2.85*	-0.04	-0.12*	0.12*	0.30	0.12
GY	Sk	0.014	2.31*	0.61	-4.29*	-3.41*	4.88*	0.22	0.67	-1.74*	1.25	-3.91*	3.43*	-5.01*	5.01*	1.47	0.60
	Mal	1.48	-3.03*	1.18	-2.98*	-0.24	5.06*	-0.22	0.62	-1.53*	2.83*	-2.11*	0.82	-1.59*	1.59*	1.54	0.63
EL	Sk	-0.45	0.13	-1.49*	0.13	1.13*	-0.01	-0.35	-0.57*	0.40	0.53*	-0.37*	1.13*	-0.30*	0.30*	0.52	0.21
	Mal	0.29	0.11	-1.56*	-0.41	0.56*	0.24	-0.01	0.06	0.84*	1.29*	-2.04*	0.62*	-0.04	0.04	0.54	0.22
ED	Sk	0.03	-0.096	-0.25*	0.03	0.03	-0.12*	-0.12*	0.28*	0.18*	0.18*	0.28*	0.13*	0.07*	-0.07*	0.11	0.04
	Mal	-0.05	-0.17*	-0.15*	0.23*	0.33*	0.23*	0.39*	-0.17*	-0.26*	0.10	-0.17*	0.03	0.01	-0.01	0.17	0.07
R/E	Sk	0.14	0.79*	0.79*	-0.74*	-0.94*	1.45*	0.76*	-0.09	0.41	0.56*	0.86*	-0.52	0.27*	-0.27*	0.47	0.19
	Mal	0.14	0.56*	0.76*	0.21	0.31	0.54*	0.81*	-0.31	-0.41	0.31	-0.01	0.01	0.08	-0.08	0.42	0.17
K/R	Sk	1.43*	0.76	-2.84*	2.03*	2.13*	1.03	-3.24*	-3.69*	-0.17	-1.17	0.78	2.96*	-0.56*	0.56*	1.37	0.56
	Mal	0.86	0.53	-3.72*	1.63	5.06*	0.58	0.08	-1.57	-1.49	0.46	-1.63*	2.52*	-0.76*	0.76*	1.68	0.68

* Significant at 0.05 level of probability.

Specific combining ability effects for agronomic traits (DS, PH, EH, EP% and E/100PL) and RLW% of 24 top-crosses at Sakha and Mallawy locations are presented in Table (6). Negative and significant estimates of SCA effects toward earliness were exhibited in top-crosses Sk5009 × Sk5 at Sakha and Sk5003 × Sd7 at Mallawy. Top-cross Sk5011 × Sk5 at Mallawy for pest ear position. Seven top-crosses (Sk5002× Sd7, Sk5003 × Sd7, Sk5004 × Sd7, Sk5008 × Sk5, Sk5010 × Sd7, Sk5011 × Sd7 and Sk5015 × Sk5) at Sakha and Sk5009 × Sk5 and Sk5012 × Sd7 at both locations exhibited desirable and significant estimates for SCA effects toward prolificacy. Moreover, seven top-crosses i.e. Sk5003 × Sk5, Sk5008 × Sk5, Sk5010 × Sd7, Sk5012 × Sd7, Sk5014 × Sk5 and Sk5016 × Sd7 at Mallawy and Sk5015 × Sd7 at both locations exhibited positive and significant estimates toward resistance to late wilt disease.

Specific combining ability effects of 24 top-crosses for grain yield and yield components traits (EL, ED, R/E and K/R) at Sakha and Mallawy locations are presented in Table (7). Six single crosses Sk5008 × Sk5, Sk5011 × Sd7 and Sk5015 × Sk5 at Sakha and Sk5009 × Sk5, Sk5010 × Sd7 and Sk5016 × Sd7 at both locations had positive and significant estimates of SCA effects toward yielding ability.

Table 6: Specific combining ability effects of 24 top-crosses for agronomic traits (DS, PH, EH, EP% and E/100PL) and RLW% at Sakha and Mallawy locations.

Crosses	DS		PH		EH		EP%		E/100pl.		RLW%	
	Sk	Mal	Sk	Mal	Sk	Mal	Sk	Mal	Sk	Mal	Sk	Mal
Sk5002 × Sk5	-0.063	0.094	4.073	0.594	4.469	1.989	0.706	0.689	-6.252*	0.827	0.167	0.120
Sk5002 × Sd7	0.063	-0.094	-4.073	-0.594	-4.469	-1.989	-0.706	-0.689	6.252*	-0.827	-0.167	-0.120
Sk5003 × Sk5	0.563	1.344*	2.198	2.094	0.469	3.865	-0.360	1.061	-6.565*	0.639	0.167	0.895*
Sk5003 × Sd7	-0.563	-1.344*	-2.198	-2.094	-0.469	-3.865	0.360	-1.061	6.565*	-0.639	-0.167	-0.895*
Sk5004 × Sk5	0.438	0.469	6.073	-3.531	0.969	-3.635	-0.743	-0.806	-9.789*	-2.873	0.187	0.057
Sk5004 × Sd7	-0.438	-0.469	-6.073	3.531	-0.969	3.635	0.743	0.806	9.789*	2.873	-0.167	-0.057
Sk5008 × Sk5	-0.063	-0.781	-4.552	-4.906	-0.656	-0.010	0.265	1.059	13.498*	3.339	0.167	0.645*
Sk5008 × Sd7	0.063	0.781	4.552	4.906	0.656	0.010	-0.265	-1.059	-13.498*	-3.339	-0.167	-0.645*
Sk5009 × Sk5	-1.688*	-0.656	0.198	3.844	4.594	6.365	1.31	1.710	10.598*	6.027*	0.167	0.120
Sk5009 × Sd7	1.688*	0.656	-0.198	-3.844	-4.594	-6.365	-1.31	-1.710	-10.598*	-6.027*	-0.167	-0.120
Sk5010 × Sk5	-0.063	-0.406	-7.427	-4.031	-6.406	-3.635	-0.620	-0.553	-5.902*	-1.973	0.167	-0.682*
Sk5010 × Sd7	0.063	0.406	7.427	4.031	6.406	3.635	0.620	0.553	5.902*	1.973	-0.167	0.682*
Sk5011 × Sk5	0.313	-0.531	-5.052	1.344	-4.906	-5.885	-0.599	-2.754*	-9.802*	-2.948	0.167	0.120
Sk5011 × Sd7	-0.313	0.531	5.052	-1.344	4.906	5.885	0.599	2.754*	9.802*	2.948	-0.167	-0.120
Sk5012 × Sk5	0.063	-0.656	0.073	4.094	0.344	0.615	0.209	-0.659	-10.489*	-6.373*	0.167	-0.443*
Sk5012 × Sd7	-0.063	0.656	-0.073	-4.094	-0.344	-0.615	-0.209	0.659	10.489*	6.373*	-0.167	0.443*
Sk5013 × Sk5	-0.063	0.469	-6.302	5.469	-5.531	3.115	-0.530	0.017	4.348	0.689	0.167	0.120
Sk5013 × Sd7	0.063	-0.469	6.302	-5.469	5.531	-3.115	0.530	-0.017	-4.348	-0.689	-0.167	-0.120
Sk5014 × Sk5	-0.563	0.219	5.823	-0.656	2.094	0.115	-0.411	0.304	2.748	0.477	0.167	0.657*
Sk5014 × Sd7	0.563	-0.219	-5.823	0.656	-2.094	-0.115	0.411	-0.304	-2.748	-0.477	-0.167	-0.657*
Sk5015 × Sk5	1.063	-0.031	6.573	-0.531	8.344	2.739	1.482	1.290	12.298*	2.889	-1.833*	-2.490*
Sk5015 × Sd7	-1.063	0.031	-6.573	0.531	-8.344	-2.739	-1.482	-1.290	-12.298*	-2.889	1.833*	2.490*
Sk5016 × Sk5	0.063	0.469	-1.678	-3.781	-3.781	-5.635	-0.688	-1.358	5.310	-0.723	0.167	-0.480*
Sk5016 × Sd7	-0.063	-0.469	1.678	3.781	3.781	5.635	0.688	1.358	-5.310	0.723	-0.167	0.480*
L.S.D at 05 for	1.129	0.965	7.882	6.815	6.482	7.768	1.868	2.167	5.339	4.819	0.389	0.420

* Significant at 0.05 level of probability.

DS: days to mid-silk, PH: plant height in cm, EH: ear height in cm, EP%: ear position % and E/100PL: number of ears/100 plants.

Table7: Specific combining ability effects of 24 top-crosses for grain yield and yield components traits (EL, ED, R/E and K/R) at Sakha and Mallawy locations.

Crosses	GY		EL		ED		R/E		K.R	
	Sk	Mal	Sk	Mal	Sk	Mal	Sk	Mal	Sk	Mal
Sk5002 × Sk5	-1.526	-1.239	0.05	-0.135	-0.017	-0.135	0.027	-0.329	-0.165	-2.536*
Sk5002 × Sd7	1.526	1.239	-0.05	0.135	0.017	0.135	-0.027	0.329	0.165	2.536*
Sk5003 × Sk5	1.094	0.320	0.125	0.560	0.008	-0.160	-0.073	0.446	-0.889	0.461
Sk5003 × Sd7	1.094	-0.320	-0.125	-0.560	-0.008	0.160	0.073	-0.446	0.889	0.461
Sk5004 × Sk5	-0.179	1.839	0.20	0.615	0.008	-0.135	-0.023	-0.554	1.160	1.989
Sk5004 × Sd7	0.179	1.839	-0.20	-0.615	-0.008	0.135	0.023	0.554	-1.160	-1.989
Sk5008 × Sk5	5.459*	1.727	0.475	-0.535	-0.117	-0.060	-0.523	-0.029	1.285	0.389
Sk5008 × Sd7	-5.459*	-1.727	-0.475	0.535	0.117	0.060	0.523	0.029	-1.285	-0.389
Sk5009 × Sk5	5.178*	2.485*	0.125	0.290	0.033	0.190	0.127	0.321	-1.515	0.914
Sk5009 × Sd7	-5.178*	-2.485*	-0.125	-0.290	-0.033	-0.190	-0.127	-0.321	1.515	-0.914
Sk5010 × Sk5	-2.164*	-3.049*	-0.175	-0.485	0.033	-0.010	0.227	-0.354	0.335	-3.415*
Sk5010 × Sd7	2.164*	3.049*	0.175	0.485	-0.033	0.010	-0.227	0.354	-0.335	3.415*
Sk5011 × Sk5	-3.326*	0.090	-0.700	0.565	-0.067	0.265*	0.0729	0.421	0.260	0.789
Sk5011 × Sd7	3.326*	-0.090	0.700	-0.565	0.067	-0.265*	-0.0729	-0.421	-0.260	-0.789
Sk5012 × Sk5	-1.998	0.670	-0.025	-0.210	0.108	0.040	-0.023	0.046	1.060	-0.261
Sk5012 × Sd7	1.998	-0.670	0.025	0.210	-0.108	-0.040	0.023	-0.046	-1.060	0.261
Sk5013 × Sk5	0.757	1.15	0.05	-0.935*	-0.067	-0.335*	0.177	-0.704	-1.265	0.364
Sk5013 × Sd7	-0.757	-1.15	-0.05	0.935*	0.067	0.335*	-0.177	0.704	1.265	-0.364
Sk5014 × Sk5	-0.004	0.509	-0.175	0.515	-0.067	0.115	0.127	-0.029	-0.315	1.764
Sk5014 × Sd7	0.004	-0.509	0.175	-0.515	0.067	-0.115	-0.127	0.029	0.315	-1.764
Sk5015 × Sk5	2.389*	-0.496	-0.125	-0.560	0.108	0.190	0.127	0.696	0.435	0.689
Sk5015 × Sd7	-2.389*	0.496	0.125	0.560	-0.108	-0.190	-0.127	-0.696	-0.435	-0.689
Sk5016 × Sk5	-3.491*	-3.986*	0.175	0.290	0.033	0.040	-0.098	0.071	-0.389	-0.224
Sk5016 × Sd7	3.491*	3.986*	-0.175	-0.290	-0.033	-0.040	0.098	-0.071	0.389	0.224
L.S.D at 05 for S_{LxT}	2.074	2.180	0.738	0.768	0.150	0.247	0.660	0.590	1.943	2.370

* Significant at 0.05 level of probability.

GY: grain yield ard/fed. EL: ear length in cm. ED: ear diameter in cm. R/E: number of rows/ear. K/R: number of kernels/row and RLW%: percentage of resistance to late wilt disease.

On the other hand, top-crosses Sk5013 × Sd7 for EL and ED; Sk5011 × Sk5 for ED; Sk5002 × Sd7 and Sk5010 × Sd7 for K/R at Mallawy had positive and significant estimates of SCA effects.

The results from SCA effects could be noticed that the best top-crosses over the 24 studied top-crosses were Sk5009 × Sk5 for yielding ability, earliness and prolificacy at both locations and Sk5010 × Sd7 for yielding ability at both locations, prolificacy at Sakha, K/R and resistance to late wilt disease at Mallawy followed by SC Sk5016 × Sd7 for yielding ability at both locations and resistance to late wilt disease at Mallawy. These promising crosses would be fruitful and candidates in future maize programs for yielding ability, earliness, prolificacy and resistance to late wilt disease.

Additive (K^2GCA) and non additive (K^2SCA) genetic effects for 11 characters at Sakha and Mallawy locations are presented in Table (8). K^2SCA played an important role in the inheritance of all traits at Mallawy location. Besides, it was controlling the inheritance of DS, E/100PL, RLW%, GY, ED and K/R at Sakha location; but the remaining traits PH, EH, EP%, EL and R/E at Sakha location controlled mainly by additive gene action. Many investigators reported that the magnitude of non-additive gene action represented the major role in the inheritance of grain yield (Kara 2001, Ashish and Singh 2002, Dodiya and Joshi 2002, Motawei *et al.* 2005 and Motawei 2006); days to 50% silking (Gul *et al.* 2000, Dubey *et al.* 2001, El-Shenawy 2005 and Motawei, 2006); plant height (Geetha and Jayaraman 2000, San *et al.* 2001 and Mosa, 2003) and late wilt resistance (Shehata, 1976, El-Itriby *et al.* 1984, Amer *et al.* 1999 and Mosa *et al.* 2004).

Table 8: Genetic components for 11 studied traits at Sakha and Mallawy Stations.

Genotypic components / Traits	K^2GCA		K^2SCA	
	Sk	Mal	Sk	Mal
Days to mid- silk	0.018	0.259	0.599	0.561
Plant height	36.92	6.93	34.34	12.86
Ear height	34.87	8.49	31.10	15.95
Ear position%	0.919	0.362	0.341	2.202
Ears/100plants	62.66	3.62	159.29	15.66
Late wilt resistance%	0.050	-0.036	0.625	1.553
Grain yield	2.88	0.558	16.84	6.284
Ear length	0.071	0.07	0.032	0.447
Ear diameter	0.000	-0.001	0.004	0.049
No. of rows/ear	0.076	0.002	-0.022	0.285
No. of kernels/row	0.525	0.577	0.727	3.543

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القدرة على التآلف لبعض سلالات من الذرة الشامية متعددة الكيزان وأخرى تحمل كوز واحد لصفة محصول الحبوب وبعض الصفات المرتبطة

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تهدف هذه الدراسة إلى قياس تأثيرات القدرة العامة والخاصة على التآلف لمجموعة من السلالات و هجنها لصفة محصول الحبوب وبعض الصفات المرتبطة به حيث تم التهجين القمى بين ١٢ سلاله جديدة من الذرة الشامية البيضاء (ستة منها متعددت الكيزان وستة أخرى تحمل كوز واحد) مع اثنين من السلالات الكشافة بمحطة البحوث الزراعية بسخا أثناء صيف ٢٠٠٧.

- تم تقييم الـ٢٤ هجين الناتجة مع اثنين من هجن المقارنة الفردية البيضاء هـ ف١٠ و هـ ف١٢٨ فى محطتى بحوث سخا وملوى فى صيف ٢٠٠٨. تم اخذ البيانات لصفات تاريخ ظهور ٥٠% من حرائر النورات المؤنثة، ارتفاع النبات، ارتفاع الكوز، موقع الكوز، عدد الكيزان/١٠٠ نبات، محصول الحبوب بالأردب للفدان وطول وقطر الكوز، عدد السطور بالكوز، عدد الحبوب بالسطر وكذلك نسبة المقاومة لمرض الذبول المتأخر .ويمكن تلخيص أهم النتائج كما يلى:-

١- وجدت اختلافات معنوية بين السلالات، الكشافات وكذلك تفاعل السلاله مع الكشاف لكل الصفات تحت الدراسة فى كلا الموقعين فيما عدا القياسات الراجعة لطول وقطر الكوز، عدد السطور بالكوز فى محطة بحوث ملوى وكذلك تفاعل السلاله × الكشاف لصفات طول الكوز وقطر الكوز وعدد السطور بالكوز وكذلك عدد الحبوب بالسطر فى محطة بحوث سخا.

٢- لعب الفعل الجينى الغير مضيف الدور الاهم فى وراثة كل الصفات تحت الدراسة بمحطة بحوث ملوى وصفات تاريخ ظهور ٥٠% من النورات المؤنثة، عدد الكيزان/١٠٠ نبات، مقاومة مرض الذبول المتاخر، محصول الحبوب، قطر الكوز وعدد الحبوب بالسطر فى محطة بحوث سخا. بينما كان للفعل الجينى المضيف الدور الاكبر فى وراثة باقى الصفات المدروسة فى محطة بحوث سخا.

٣- كانت أفضل السلالات فى القدرة العامة على التآلف فى كلا الموقعين هى سخا ٥٠٠٨ لصفات التبكير، قصر النبات وموقع الكوز المنخفض وكذلك السلالاتين سخا ٥٠٠٤ وسخا ٥٠١٢ لصفة تعدد الكيزان وبالمثل السلالاتين سخا ٥٠٠٩، سخا ٥٠١٦ لطول الكوز وعدد الحبوب بالسطر والسلالة سخا ٥٠١٠ لصفة المحصول وعدد السطور بالكوز . كانت السلالة سدس٧ أفضل السلالات الكشافة للقدرة العامة على التآلف لصفات محصول الحبوب ومقاومة مرض الذبول المتأخر بينما كانت السلالة سخا٥ من أفضل الكشافات للقدرة العامة على التآلف لصفات للتبكير وموقع الكوز الجيد فى كلا الموقعين.

٤- اظهر الهجين القمي سخا ٥٠٠٩ × سخا٥ تأثيرات مرغوبة للقدرة الخاصة على التالف للمحصول والتبكير وتعدد الكيزان وكذلك اظهر الهجينان سخا ٥٠١٠ × سدس ٧ وسخا ٥٠١٦ × سدس ٧ تأثيرات مرغوبة لتأثيرات القدرة الخاصة على التالف للقدرة المحصولية فى كلا الموقعين.

٥- أظهرت تسعة هجن قمية فى محطة بحوث سخا وهى سخا ٥٠١٠× سدس ٧ ، سخا٥٠١٦× سدس٧ ، سخا٥٠١١× سدس٧ ، سخا ٥٠٠٣× سدس٧، سخا ٥٠١٢× سدس٧، سخا٥٠٠٢× سدس٧، سخا٥٠١٤ × سدس٧، سخا٥٠٠٤× سدس٧ وسخا ٥٠١٣ × سدس٧ وكذلك الهجين القمى سخا٥٠١٠× سدس٧ بمحطة بحوث ملوى تفوقا معنويا عن أفضل هجن المقارنة هـ.ف١٠. وفى نفس الوقت تميزت هذه الهجن بالتبكير وموقع جيد للكوز، وتعدد الكيزان ومقاومة مرض الذبول المتأخر ومع ذلك فان هذه الهجن الفردية الجديدة تحتاج لتجارب أوسع قبل أطلاقها كهجن ثابته فى صفات المحصول مع بعض الصفات الاقتصادية الهامة.