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Evaluation of Combining Ability and Heterosis for Earliness and Growth Traits of some Sunflower Genotypes under Water Stress Conditions

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ABSTRACT

Six divergent sunflower genotypes were coupled using a half-diallel mating design to determine types of combining abilities, and heterosis under normal irrigation and water stress conditions for earliness and maturity traits as well as growth traits, in Kafr–El–Mayasra Village, EL-Zarqa District, Damietta Governorate, Egypt during the summer seasons 2019 and 2020. The parents and their F_1 crosses were evaluated using a design of randomized complete blocks with 3 replicates. The GCA/SCA ratio under normal irrigation and water stress conditions revealed a predominance of non-additive gene action for earliness and maturity traits as well as growth traits. For days to full maturity, Sakha 53 at normal-watering and L-105 at moisture-stress conditions, and L-216 under normal-watering and L-105 under moisture-stress conditions for no. of green leaves were the best general combiners. The generated combinations Sakha 53 × L-105 for days to full maturity, L-10 × L-216 for no. of green leaves plant^{-1}, and L-8 × Sakha 53 for stem diameter under both irrigation treatments had desirable SCA effects as well as mid and better parents heterosis.

***Keywords*:** Sunflower, combining ability, mid and better parent heterosis.

INTRODUCTION

Sunflower is one of the substantial oil crops in Egypt, and the agricultural policy in Egypt is concerned with expanding its cultivation, as it has a great potential to increase the local oil production to cover the growing domestic consumption of edible oil. Induced genetic variation in the sunflower population is an important target of the breeding program to improve the yield and oil quality potential of genotypes.

Continuously, half diallel crossing among sensitive and tolerant sunflower genotypes has been also investigated to guesstimate the combining abilities, heterosis and type4 of gene action for all considered characters at normal-watering and water-stress conditions to choose the most efficient breeding procedure for achievement of maximum genetic improvement for water stress tolerance.

Of them, Gomez-Sanchez *et al*. (1999) in Mexico, mentioned that general combining ability was more important than specific combining ability for stem dry weight, total dry weight and head weight. They added that dominance variance was more important for days to beginning of flowering, days to the end of flowering, days to physiological maturity, reproductive index, plant height, leaf dry weight and achene yield. Furthermore, Khani *et al*. (2005) in Iran, indicated that the general combining ability/specific combining ability ratio revealed that under no-stress conditions, the non-additive (dominance) variance was significant and more important in the expression of 1000-seed weight than the additive one. In addition, Sultan, *et al*. (2009a), Sultan, *et al*, (2009b), Sultan, *et al*. (2010), Abd El-Satar, *et al*. (2015), Abd El-Satar (2017), Ahmed, *et al*. (2019), Abdelsatar, *et al*. (2020), Abdelsatar and Hassan (2020), and Ibrahim, Suzan *et al*. (2021) found that both additive and non-additive gene actions were significant in the expression of examined traits, with a predominance of non-additive gene action for most traits. As a consequence, precise genetic information on earliness and maturity traits as well as growth traits inherited in these breeding materials provides the best opportunity for designing efficient breeding program and/or selection techniques to improve these traits in sunflower.

MATERIALS AND METHODS

A field experiment was conducted at the Experimental Farm at Kafr–El–Mayasra Village, EL-Zarqa District, Damietta Governorate, Egypt during the summer seasons of 2019 and 2020.

In the first growing season 2019, the six parental sunflower genotypes were sown i.e., L-8, L-10, L-19, L-105, Sakha-53 and L-216, and hence hand hybridization in a diallel fashion excluding reciprocal was done to produce 15 F_1 crosses. These genetic materials which were used in this investigation as parents instead of a widespread series of multiplicity for numerous agronomical traits. The designations and the origin of these parental genetic constitution are offered in Table-1.

In the evaluated season 2020, the parents and their F_1 crosses were sown under normal irrigation and water stress conditions.

In the evaluated season 2020, each of 21 sunflower genotypes involved 15 F_{1S} crosses together with the six parental sunflower genotypes was consecutive sown under two irrigation treatments (normal irrigation and water stress conditions), since separation distance between two irrigation treatments was 5 m.

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In evaluated season 2020, two separate field experiments were conducted, the first represents normal irrigation treatment (plants watered every 15 days, as control treatment) and the second represents water stress treatment (plants watered every 30 days until harvest to achieve severe drought stress through planting after sowing according to Kiani *et al*. (2007).

Each irrigation treatment was designed as a separate experiment in a design of randomized-complete-blocks (RCBD) with 3 replications.

Table 1. Parents names and their origin

No	Parental genotypes	Origin
P1	L-8	Egypt
P2	L-10	Egypt
P3	L-19	Bulgaria
P4	Sakha-53	Local variety
P5	L-105	Bulgaria
P6	L-216	Bulgaria

In the crossing season 2019, each of six sunflower genotypes was sown in 4 ridges, 60 cm apart and 3 m long, distance between hills was 20 cm.

In the evaluated season 2020, each replicate complicated of 21 genetic constitutions in addition to two borders, each genetic constitution was sown in one single ridge, in length 5 m, and in width 60 cm with 20 cm among plants. Two seeds were dropped by hand in each ridge and then the thinning was done after 15 days after sowing.

Agricultural practices:

Planting date was done on May 22 in the first season and August 5 in the second season. Hoeing in both seasons was practiced before and after the first irrigation. The other agricultural practices were applied as recommended.

Collected data

A-Earliness and maturity traits:

Earliness and maturity traits were randomly recorded based on plot basis in each replication. Earliness and maturity traits represented in days number to 1st flower, days number to fifty-percent flowering, days number to full flowering, days number to physiological-maturity and days number to full-maturity.

B- Growth traits:

At maturity,10 sunflower plants were randomly taken from each genotype in each replication for recording the growth traits. Growth traits represented in no. of green leaves/plant, plant height (cm) and stem diameter (cm).

Statistical analyses:

Analysis of variance:

All gotten data were exposed to the statistical analysis of the Design of Randomized-Complete-Blocks (RCBD) to examine the variances among numerous genotypes at all normal-watering and moisture-stress conditions according to Snedecor and Cochran (1980). Treatments were comparison using the least differences values (LSD) at 5% and 1% levels of probability according to Gomez and Gomez (1984).

Estimation of heterosis:

Heterosis as suggested by Mather and Jinks (1982) was specified for individual crosses as the percentage variation of F_1 means from mid-parent (MP) and better parent (BP) means and expressed as percentages for each normal watering and water stress as follows:

Heterosis over the mid parents (H_{MP}) % = (F_1-MP)/MP × 100

Heterosis over the better parents (H_{BP}) % = (F_1 – BP)/BP × 100

Where: **F_1 = mean values of the 1st generation, MP = value of the mean of the mid parents computed by utilizing the median mean of the two parents and BP = value of mean of the better parents.**

The heterosis impact significance for F_1 values for the mid and better parents were tested agreeing to the subsequent recipe:

LSD for heterosis over mid parents = t (0.05 or 0.01) x (3MSe/2r)$^{1/2}$

LSD for heterosis over better parents = t (0.05 or 0.01) x (2MSe/r)$^{1/2}$

Where: **t= value of tabulated "t" at stated level of probability for degrees of freedom of the experimental error, M_{Se} = experimental error mean squares from the analysis of variance, and r = replicates number.**

Diallel analyses

1- Estimation of combining ability analysis:

Data for all investigated properties were analyzed according to Griffing's method (1956)-2, and Model-1 (constant) to determine the effects of general (GCA) and special (SCA) abilities. The comparative reputation of GCA to SCA is explained as follows:

K^2gca/K^2sca = [M.S.gca –M.S.e/(p +2)]/(M.S.sca –M.S.e)

Where: **M.S.=mean squares, P=parents' number, and K^2=effects average squares.**

RESULTS AND DISCUSSION

1-Analysis of variance

A-Earliness and maturity traits:

It is apparent from the results, as shown in Table-2, that mean squares due to genotypes and their partitioning into parents, crosses and parents × crosses (P × C) were highly significant for earliness and maturity traits i.e. days to 1st flowering, days to 50% flowering, days to full flowering, days to physiological maturity and days to full maturity under normal irrigation and water stress conditions.

Mean squares due to parents *vs*. crosses, as an indication to average heterosis overall crosses, were highly significant for days to 1st flowering, days to 50% flowering, days to full flowering, days to physiological maturity and days to full maturity under both irrigation regimes, indicating the presence of significant heterosis under both irrigation regimes.

Table 2. Mean squares of sunflower genetic constitution, parents, crosses and parents versus crosses for all flowering and maturity characters at normal-watering (N) and moisture-stress (S) conditions.

SV	df	Days to 1st flower		Days to 50% flowering		Days to full flowering	
		N	S	N	S	N	S
Genotypes	20	19.68**	26.69**	17.47**	26.46**	21.99**	26.03**
Parents	5	10.06**	11.12**	15.56**	11.33**	6.72**	4.89**
Crosses	14	7.55**	11.30**	6.76**	6.09**	10.41**	5.02**
P. V Cross	1	237.73**	320.00**	177.07**	387.36**	260.36**	425.91**
Error	40	0.99	0.85	1.14	1.04	1.05	0.69

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

Table 2. Continued

S.V	df	Days to physiological maturity		Days to full maturity	
		N	S	N	S
Genotypes	20	19.39**	19.60**	13.89**	17.13**
Parents	5	4.19**	7.47**	5.47**	2.27**
Crosses	14	4.94**	5.33**	3.52**	4.60**
P. V Cross	1	297.60**	280.00**	201.17**	266.83**
Error	40	1.15	0.80	0.98	0.59

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

These results indicating the wide diversity among the parental material and enough genetic variability adequate for further biometrical assessment. This result is in agreement with the results of Sultan, *et al*. (2009a), Sultan, *et al*, (2009b), Sultan, *et al*. (2010), Abd El-Satar, *et al*. (2015), Abd El-Satar (2017), Ahmed, *et al*. (2019), Abdelsatar, *et al*. (2020), Abdelsatar and Hassan (2020), and Ibrahim, Suzan *et al*. (2021).

Irrigation effects:

Mean squares due to irrigation (Table-3) were highly significant for all earliness and maturity traits, indicating overall differences between two irrigations treatments.

Mean squares due to interaction of irrigation with genotypes *i.e.*, parentages, crosses and parents vs. crosses were distinguished for days to 1st flowering, days to 50% flowering, days to full flowering, days to physiological maturity and days to full maturity, revealing that irrigation had considerable environmental variation caused in changes in the ordering of all inhabitants components, i.e., respectful retorts of various genetic constitutions and classified differently from irrigation treatment to anther irrigation treatment.

This result is in agreement with the results of Sultan, *et al*. (2009a), Sultan, *et al*, (2009b), Sultan, *et al*. (2010), Abd El-Satar, *et al*. (2015), Abd El-Satar (2017), Ahmed, *et al*. (2019), Abdelsatar, *et al*. (2020), Abdelsatar and Hassan (2020), and Ibrahim, Suzan *et al*. (2021).

Table 3. The combined-analysis of variance for earliness and maturity characters at the two irrigation treatments in season of 2020.

Source of variance	d.f	Days to 1st flower	Days to 50% flowering	Days to full flowering	Days to physiological maturity	Days to full maturity
Irrigation (I)	1	950.13**	384.13**	640.13**	548.96**	1170.29**
Rep.× I	4	0.42	0.32	0.75	0.65	0.40
Genotypes (G)	20	10.95**	9.61**	11.41**	9.17**	7.49**
G × I	20	35.42**	34.32**	36.61**	29.82**	23.53**
Parents	5	3.36**	3.81**	2.21*	1.91	1.52
P × I	5	17.82**	23.08**	9.40**	9.75**	6.22**
Crosses (C)	14	4.53**	2.66**	3.43**	2.10*	1.84**
C × I	14	14.31**	10.19**	12.00**	8.18**	6.28**
P × C	1	138.67**	136.03**	169.03**	144.37**	116.42**
P × C × I	1	419.06**	428.40**	517.23**	433.23**	351.57**
Error	80	0.92	1.09	0.87	0.98	0.79

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

b-Growth traits:

This group of traits included three traits, *i.e.,* green leaves number plant^{-1}, plant height and stem diameter. The analysis of variance for the six parental genotypes and 15 F_1 hybrids for these traits are presented in Table-4.

The results indicated that mean squares due to genotypes, and their components as parents and hybrid sunflower combinations were highly significant for growth characters. These revealed that significant variation within traits which indicate considerable diverse among genotypes.

Similarly, the mean squares of parents *vs.* crosses were found to be highly significant for growth characters. Parents vs. crosses mean squares as sign to average of heterosis overall crosses were found to be highly significant for achene yield and its components. This result is in cotract with the results of Sultan, *et al*. (2009a), Sultan, *et al*, (2009b), Sultan, *et al*. (2010), Abd El-Satar, *et al*. (2015), Abd El-Satar (2017), Ahmed, *et al*. (2019), Abdelsatar, *et al*. (2020), Abdelsatar and Hassan (2020), and Ibrahim, Suzan *et al*. (2021).

Table 4. Mean squares of sunflower genotypes, parents, crosses and parents versus crosses for growth characters under normal-watering (N) and moisture-stress (S) conditions.

S. V	D.F	Green leaves number plant^{-1}		Height of plant (cm)		Stem diameter (cm)	
		N	S	N	S	N	S
Genotypes	20	102.35**	102.73**	240.108**	279.965**	0.22**	0.17**
Parents	5	127.12**	127.12**	218.446**	235.855**	0.20**	0.17**
Crosses	14	94.12**	94.56**	121.525**	127.218**	0.11**	0.06**
P. V Cross	1	93.73**	95.28**	2008.571**	2638.972**	1.75**	1.60**
Error	40	0.30	0.32	8.628	7.180	0.01	0.01

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

Irrigation effects:

Mean squares due to irrigation (Table-5) were highly significant for growth characters, indicating overall the differences between two irrigations treatments.

Mean squares due to interaction of irrigation with genotypes as parentages, crosses and parents *vs* crosses were distinguished for growth traits, revealing that irrigation had considerable environmental variation caused in changes in the ordering of wholly populace components, *i.e.,* respectful rejoinders of various genotypes and classified in a different way from irrigation treatment to another irrigation treatment. These results are in arrangement with the outcomes of Sultan, *et al*. (2009a), Sultan, *et al*, (2009b), Sultan, *et al*. (2010), Abd El-Satar, *et al*. (2015), Abd El-Satar (2017), Ahmed, *et al*. (2019), Abdelsatar, *et al*. (2020), Abdelsatar and Hassan (2020), and Ibrahim, Suzan *et al*. (2021).

Table 5. The combined-analysis of variance for growth characters under the 2 irrigation treatments in season of 2020.

Source of variance	d.f	No. of green leaves plant^{-1}	Plant height	Stem diameter
Irrigation (I)	1	280.51**	2991.057**	0.82**
Rep.× I	4	0.25	5.712	0.01
Genotypes (G)	20	51.27**	118.448**	0.09**
G × I	20	153.81**	401.625**	0.29**
Parents	5	63.56**	113.142**	0.09**
P × I	5	190.68**	341.159**	0.27**
Crosses (C)	14	47.17**	46.196**	0.04**
C × I	14	141.51**	202.548**	0.14**
P × C	1	47.25**	1156.517**	0.84**
P × C × I	1	141.76**	3491.027**	2.51**
Error	80	0.31	7.904	0.01

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

2: Analysis of variance for combining ability:

A-Earliness and maturity traits:

Analysis of variance of combining ability for the studied earliness and maturity traits are offered in Table-6.

Mean squares of GCA and SCA were significant or highly significant for all the studied earliness and maturity characters, revealing the existence of both types of genes, additive and non-additive (dominance and epistasis), in the genetic system monitoring these characteristics. This result agrees with the results of Sultan, *et al*. (2009a), Sultan, *et al*, (2009b), Sultan, *et al*. (2010), Abd El-Satar, *et al*. (2015), Abd El-Satar (2017), Ahmed, *et al*. (2019), Abdelsatar, *et al*. (2020), Abdelsatar and Hassan (2020), and Ibrahim, Suzan *et al*. (2021).

Table 6. General (GCA) and specific (SCA) combining abilities mean squares, and ratio of GCA/SCA for earliness and maturity traits under normal-watering (N) and moisture-stress (S) conditions.

S.V	D.F	Days to 1st flower		Days to 50% flowering		Days to full flowering	
		N	S	N	S	N	S
GCA	5	6.03**	4.95**	3.83**	3.06**	6.03**	1.86**
SCA	15	6.74**	10.21**	6.49**	10.74**	6.74**	10.95**
Error	40	0.33	0.28	0.38	0.35	0.33	0.23
GCA/SCA	-	0.64	0.49	0.54	0.36	0.64	0.25

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

Table 6. Continued

S.V.	D.F	Days to physiological maturity		Days to full maturity	
		N	S	N	S
GCA	5	3.01**	2.32**	1.50**	1.25**
SCA	15	7.61**	7.94**	5.67**	7.20**
Error	40	0.38	0.27	0.33	0.20
GCA/SCA	-	0.44	0.37	0.35	0.26

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

However, the gotten results discovered that the GCA/SCA ratios under the two conditions were less than unity for earliness and maturity traits, indicating that these characters are mainly controlled by gene action of non-additive (dominance and epistasis). It consequently could be decided that procedures of selection constructed on the buildup of additive effects would be extra operative in the late segregating generations. These outcomes are in harmony with Sultan, *et al*. (2009a), Sultan, *et al*, (2009b), Sultan, *et al*. (2010), Abd El-Satar, *et al*. (2015), Abd El-Satar (2017), Ahmed, *et al*. (2019), Abdelsatar, *et al*. (2020), Abdelsatar and Hassan (2020), Ibrahim, Suzan *et al*. (2021).

B-Growth traits:

Analyses of variance for combining-abilities of growth characteristics are offered in Table-7. The results clearly showed that the mean squares of genotypes were highly significant for all studied earliness and maturity characters.

Mean squares of general (GCA) and specific (SCA) combining ability were significant or highly significant for all studied earliness and maturity characters under normal and water stress conditions, demonstrating the existence of both types of genes, additive and non-additive (dominance and epistasis), in the genetic structures monitoring these characters. This result agrees with results of Sultan, *et al*. (2009a), Sultan, *et al*, (2009b), Sultan, *et al*. (2010), Abd El-Satar, *et al*. (2015), Abd El-Satar (2017), Ahmed, *et al*. (2019), Abdelsatar, *et al*. (2020), Abdelsatar and Hassan (2020), and Ibrahim, Suzan *et al*. (2021).

The attained results discovered that the GCA/SCA ratios were less than unity for all considered growth characters under standard-watering and water-deficit-stress conditions. These results recommend that considered characters are principally controlled by non-additive (dominance and epistasis) gene actions, as shown in Table-7. Therefore, it could be decided that selection procedures would be fruitful in improving these characters and selection would be more effective in the late segregating generations. Similar results were obtained by Abd El-Satar, *et al*. (2015), Abd El-Satar (2017), Ahmed, *et al*. (2019), Abdelsatar, *et al*. (2020), Abdelsatar and Hassan (2020), and Ibrahim, Suzan *et al*. (2021)

Table 7. Mean squares of general (GCA) and specific (SCA) combining abilities, and GCA/SCA ratio for growth traits under normal normal-watering (N) and moisture-stress (S) conditions.

S.V	D.F	No. of green leaves plant^{-1}		Plant height		Stem diameter	
		N	S	N	S	N	S
GCA	5	63.76**	63.58**	121.71**	87.07**	0.04**	0.03**
SCA	15	24.24**	24.46**	66.14**	95.41**	0.08**	0.06**
Error	40	0.10	0.11	2.88	2.39	0.00	0.00
GCA/SCA	-	0.84	0.84	0.79	0.65	0.50	0.48

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

3-General combining ability (GCA) effects:

A-Earliness and maturity traits:

Estimates of general combining ability effects of all the parental genotypes for earliness and maturity characters under normal watering and water stress conditions are presented in Table-8.

Significant negative GCA values would be the best combiners for earliness and maturity characters. The best general combiners for days to 1st flowering under both normal irrigation and water stress conditions were all parents except P1 (L8) which recorded significant and positive GCA effects for this character.

The best general combiners for days to 50% flowering were P_4 (Sakha 53) under normal condition and P_3 (L19) under water stress, as they recorded highly significant and negative GCA effects for this character. P2 (L10) had negative and significant GCA effects for days to full flowering and days to physiological maturity under normal and water stress conditions, hence it could be considered as a good general combiner for earliness in these traits. In case of days to full maturity, Sakha 53 under normal watering and L105 and L216 under water stress conditions had negative and significant GCA effects, hence these parents could be considered as good general combiners in these cases. This result is in contract with the results of Sultan, *et al*. (2009a), Sultan, *et al*, (2009b), Sultan, *et al*. (2010), Abd El-Satar, *et al*. (2015), Abd El-Satar (2017), Ahmed, *et al*. (2019), Abdelsatar, *et al*. (2020), Abdelsatar and Hassan (2020), Ibrahim, Suzan *et al*. (2021).

Table 8. General combining ability effects of parental sunflower genotypes for earliness and maturity traits under normal normal-watering (N) and moisture-stress (S) conditions.

Parents	Days to 1st flower		Days to 50% flowering		Days to full flowering	
	Normal	W-Stress	Normal	W-Stress	Normal	W-Stress
L8	1.60**	1.03**	0.67**	0.81**	1.10**	0.33*
L10	-0.57**	0.40*	-0.25	-0.28	-1.44**	-0.83**
L19	-0.03	0.07	-0.17	-0.90**	-0.28	-0.12
Sakha 53	-0.94**	-1.35**	-1.04**	-0.32	-0.28	-0.17
L105	-0.03	0.07	-0.08	0.47*	0.68**	0.38*
L216	-0.03	-0.22	0.88**	0.22	0.22	0.42*
LSD 5% Gi	0.38	0.35	0.40	0.38	0.39	0.31
LSD 1% Gi	0.50	0.46	0.54	0.52	0.52	0.42
LSD 5% Gi-GJ	1.03	0.95	1.10	1.06	1.06	0.86
LSD 1% Gi-GJ	1.38	1.27	1.48	1.41	1.42	1.15

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

Table 8. Continued

Parents	Days to physiological maturity		Days to full maturity	
	Normal	W-Stress	Normal	W-Stress
L8	-0.24	0.21	0.72**	0.39**
L10	-0.99**	-1.04**	-0.07	0.43**
L19	-0.03	0.08	-0.24	0.22
Sakha 53	0.18	0.38*	-0.36	-0.19
L105	0.18	0.42*	-0.36	-0.44**
L216	0.89**	-0.04	0.31	-0.40**
LSD 5% Gi	0.40	0.34	0.37	0.29
LSD 1% Gi	0.54	0.45	0.50	0.39
LSD 5% Gi-GJ	1.11	0.93	1.03	0.80
LSD 1% Gi-GJ	1.49	1.24	1.37	1.06

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

B-Growth traits:

Significant positive GCA values would be the best general combiners for number of green leaves plant^{-1} and stem diameter, conversely the parental lines had significant negative GCA were desirable for plant height. The best general combiner for number of green leaves/plant were L216 followed by Sakha 53 under normal irrigation and L105 followed by L216 and Sakha 53 under water stress conditions, as they recorded significant or highly significant and positive GCA effects for this character. Good general combiners for decreasing plant height (shortness), were Sakha 53 followed by L216 under normal irrigation and water stress condition, as it registered highly significant and negative GCA effects. L19 under normal and water stress conditions had significant positive GCA effects for stem diameter, hence it could be regarded as the best general combiners for thickness of plants under both irrigation conditions, as presented in Table-9. This result is in contract with the results of Sultan, *et al.* (2009a), Sultan, *et al*, (2009b), Sultan, *et al*. (2010), Abd El-Satar, *et al*. (2015), ,Abd El-Satar (2017), Ahmed, *et al*. (2019), Abdelsatar, *et al*. (2020), Abdelsatar and Hassan (2020), Ibrahim, Suzan *et al*. (2021).

Table 9. General combining ability effects of parental sunflower genotypes for growth traits under normal-watering (N) and moisture-stress (S) conditions.

Parents	No. of green leaves plant^{-1}		Plant height		Stem diameter	
	Normal	W-Stress	Normal	W-Stress	Normal	W-Stress
L8	-1.78**	-1.79**	1.54**	1.21*	-0.06**	-0.02
L10	-2.74**	-2.71**	5.56**	2.79**	0.01	-0.01
L19	-2.90**	-2.92**	2.35**	3.10**	0.08**	0.06**
Sakha 53	1.39**	1.42**	-4.77**	-4.99**	-0.11**	-0.10**
L105	3.60**	3.58**	-1.02	0.99	0.03	0.02
L216	2.43**	2.42**	-3.67**	-3.11**	0.06**	0.06**
LSD 5% Gi	0.21	0.21	1.11	1.01	0.03	0.03
LSD 1% Gi	0.28	0.29	1.48	1.35	0.04	0.04
LSD 5% Gi-GJ	0.57	0.59	3.04	2.77	0.08	0.08
LSD 1% Gi-GJ	0.76	0.79	4.07	3.71	0.11	0.11

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

4- Specific combining ability (SCA) effects:

A-Earliness and maturity traits

Significant negative SCA values would be the best crosses for earliness and maturity traits would be useful from the breeder's point of view. Based on specific combining ability estimates (Table-10), it could concluded that the best crosses combination L10 × Sakha 53 for earliness characters under both normal and water stress irrigation and Sakha 53 × L105 for maturity traits under both normal and water stress irrigation conditions.

Table 10. Specific combining ability (SCA) effects of sunflower crosses for earliness and maturity characters under normal-watering (N) and moisture-stress (S) conditions.

Crosses	Days to 1st flower		Days to 50% flowering		Days to full flowering	
	Normal	W-Stress	Normal	W-Stress	Normal	W-Stress
L8 × L10	-1.35**	-1.59**	0.01	-1.27**	-0.83	-0.83*
L8 × L19	-0.89*	0.41	-2.07**	-2.32**	-0.99*	0.13
L8 × Sakha 53	-0.64	0.49	0.14	-1.90**	-1.66**	-0.83*
L8 × L105	-2.22**	-1.92**	-1.15*	-1.36**	-1.29**	-2.71**
L8 × L216	-1.89**	-0.96*	-2.45**	-3.11**	-1.16*	-1.08**
L10 × L19	-0.39	-1.63**	-2.15**	-0.90*	0.55	-0.38
L10 × Sakha 53	-4.47**	-6.21**	-3.95**	-4.82**	-5.45**	-4.33**
L10 × L105	-1.05*	-1.30**	-0.90	-1.61**	-0.74	-1.88**
L10 × L216	-1.05*	-2.01**	-1.53**	-1.69**	-1.62**	-1.25**
L19 × Sakha 53	-1.01*	-0.55	0.64	0.48	-1.62**	-2.71**
L19 × L105	-0.60	-1.30**	-0.65	-0.65	-1.24**	-1.92**
L19 × L216	-0.60	-1.01*	-1.95**	-1.40**	-1.45**	-1.63**
Sakha 53 × L105	-1.68**	-1.21**	0.22	-2.23**	-0.58	-1.54**
Sakha 53 × L216	-0.68	-1.59**	1.93**	-1.32**	-0.12	-1.92**
L105 × L216	0.07**	-1.01**	-2.03**	0.56**	-1.08**	-1.79**
LSD 5% (SIJ)	0.85	0.79	0.91	0.87	0.88	0.71
LSD 1% (SIJ)	1.14	1.05	1.22	1.17	1.17	0.95
5% (SIJ-SIK)	1.54	1.42	1.65	1.58	1.58	1.28
1% (SIJ – SIK)	2.06	1.90	2.21	2.11	2.12	1.71
5% (SIJ- SKI)	1.43	1.32	1.53	1.46	1.47	1.19
1% (SIJ – SKI)	1.91	1.76	2.04	1.95	1.96	1.59

***, ** significant at 0.05 and 0.01 level of probability , respectively**

Table 10. Continued

Crosses	Days to physiological maturity		Days to full maturity	
	Normal	W-Stress	Normal	W-Stress
L8 × L10	-1.62**	0.83*	-1.16**	-0.57
L8 × L19	0.42	0.04	-1.66**	-2.02**
L8 × Sakha 53	-1.12*	-0.92*	-0.20	-0.27
L8 × L105	-1.79**	-1.96**	-1.54**	-2.36**
L8 × L216	-1.83**	-1.83**	-2.87**	-2.40**
L10 × L19	-2.16**	-1.71**	-1.87**	-2.07**
L10 × Sakha 53	-1.70**	-3.67**	-0.74	-1.32**
L10 × L105	-0.04	-0.38	-1.08*	-1.40**
L10 × L216	-2.74**	-1.25**	-1.08*	-0.77*
L19 × Sakha 53	-2.99**	-2.79**	-0.58	-0.44
L19 × L105	-1.99**	-3.17**	0.76	0.81*
L19 × L216	-0.37	-1.37**	-1.91**	-1.90**
Sakha 53 × L105	-0.20	-0.79*	-3.12**	-3.77**
Sakha 53 × L216	-0.91	-0.33	-0.45	-0.82*
L105 × L216	-1.58**	-0.71**	0.55**	-0.23**
LSD 5% (SIJ)	0.92	0.76	0.85	0.66
LSD 1% (SIJ)	1.23	1.02	1.13	0.88
5% (SIJ-SIK)	1.66	1.38	1.53	1.19
1% (SIJ – SIK)	2.22	1.85	2.05	1.59
5% (SIJ- SKI)	1.53	1.28	1.42	1.10
1% (SIJ – SKI)	2.05	1.71	1.90	1.47

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

This result is in contract with the results of Sultan, *et al.* (2009a), Sultan, *et al*, (2009b), Sultan, *et al.* (2010), Abd El-Satar, *et al.* (2015), ,Abd El-Satar (2017), Ahmed, *et al.* (2019), Abdelsatar, *et al.* (2020), Abdelsatar and Hassan (2020), Ibrahim, Suzan *et al.* (2021).

B-Growth traits:

Significant positive SCA values would be the best crosses for no. of green leaves plant^{-1} and stem diameter would be useful from the breeders point of view. Based on specific combining ability estimates, it could be concluded that the best crosses were L10 × L216 followed by L8 × L19 under both normal-watering and water stress conditions for no. of green leaves plant^{-1} and L8 × Sakha 53 for stem diameter under both normal-watering and water stress conditions, as they recorded significant or highly significant and positive SCA effects for this character. Moreover, significant negative SCA values would be the best crosses for plant height (shortness) L19 × L216 followed by Sakha 53 × L216 under normal irrigation and L10 × Sakha 53 followed by L19 × L216 under water stress conditions (Table-11).

Table 11. Specific combining ability (SCA) effects of sunflower crosses for growth traits under normal-watering (N) and moisture-stress (S) conditions.

Crosses	No. of green leaves plant^{-1}		Plant height		Stem diameter	
	Normal	W-Stress	Normal	W-Stress	Normal	W-Stress
L8 × L10	-0.47*	-0.50*	-6.89**	-7.44**	0.12**	0.13**
L8 × L19	6.36**	6.38**	-5.51**	-5.72**	0.11**	0.12**
L8 × Sakha 53	-5.60**	-5.63**	-2.73*	-1.27	0.45**	0.43**
L8 × L105	3.86**	3.88**	3.65**	1.99	0.19**	0.21**
L8 × L216	6.03**	6.04**	0.27	-3.57**	-0.23**	-0.23**
L10 × L19	-4.01**	-4.04**	-6.73**	-3.67**	-0.12**	0.02
L10 × Sakha 53	5.03**	5.29**	-1.21	-18.68**	0.22**	0.22**
L10 × L105	0.82**	0.79**	-2.06	0.44	0.31**	0.15**
L10 × L216	6.99**	6.96**	-3.57**	-5.68**	0.15**	0.16**
L19 × Sakha 53	-0.80**	-0.83**	5.00**	3.94**	0.21**	0.18**
L19 × L105	-2.01**	-2.00**	-5.19**	-7.90**	0.36**	0.17**
L19 L216	-5.85**	-5.83**	-11.00**	-10.56**	-0.06	-0.03
Sakha 53 × L105	-3.30**	-3.33**	-8.20**	-3.38**	-0.19**	-0.08*
Sakha 53 × L216	2.86**	2.83**	-8.58**	-0.67	0.05	-0.05
L105 × L216	1.65**	1.67**	-0.83**	0.78**	0.03**	0.13**
LSD 5% (SIJ)	0.47	0.49	2.51	2.29	0.07	0.07
LSD 1% (SIJ)	0.63	0.65	3.36	3.06	0.09	0.09
5% (SIJ-SIK)	0.85	0.88	4.53	4.14	0.12	0.12
1% (SIJ – SIK)	1.13	1.18	6.07	5.53	0.17	0.16
5% (SIJ- SKI)	0.78	0.81	4.20	3.83	0.12	0.11
1% (SIJ – SKI)	1.05	1.09	5.62	5.12	0.15	0.15

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

This result is in contract with the results of Sultan, *et al.* (2009a), Sultan, *et al*, (2009b), Sultan, *et al.* (2010), Abd El-Satar, *et al.* (2015), ,Abd El-Satar (2017), Ahmed, *et al.* (2019), Abdelsatar, *et al.* (2020), Abdelsatar and Hassan (2020), Ibrahim, Suzan *et al.* (2021).

5- Heterosis percentages:

Finished to the original sin of inbreeding depression is its opposite, "hybrid vigor" or heterosis. When inbred lines are crossed, their offspring shows an increase of those characters that previously suffered a decreased from inbreeding. Or, generally, the fitness which was missing by inbreeding depression can be restored by crossing. The amount of heterosis is the variation between the crossbred and inbred means. Sunflower shows hybrid vigor when hybridization occurs between varieties.

A-Earliness and maturity traits

Results given in Table-12 showed that the valuable cross combinations L10 × Sakha 53 under both water irrigation regimes recorded the highest negative significant heterosis over mid and better-parents for days to 1st flowering. For days to 50% flowering under normal-watering and water stress conditions, the cross combination L10 × Sakha 53 for mid-parent heterosis and L10 × L19 for better-parent heterosis under normal irrigation and L10 × Sakha 53 for mid and better parent under water stress conditions. The considerable cross combinations L10 × Sakha 53 had the highest negative significant heterosis over mid and better-parents for days to full flowering under both water irrigation treatments. The highest negative significant cross combination for days to physiological maturity was detected in L10 × L216 for mid-parent heterosis and L19 × Sakha 53 for better parent heterosis under normal irrigation and L10 × Sakha 53 for mid-parent heterosis and L19 × L105 for better parent heterosis under water stress conditions. The considerable negative cross combinations L8 × L216 followed by Sakha 53 × L105 for mid-parent heterosis and Sakha 53 × L105 followed by L8 × L216 under normal irrigation for days to full maturity. The highest significant negative heterosis over mid and better-parent for days to maturity and days to full maturity were recorded by Sakha 53 × L105 followed by L8 × L105 under normal-watering and water stress conditions, respectively.

B-Growth traits

For no. of green leaves plant^{-1}, the highest positive significant cross combinations L10 × L216 for mid-parents heterosis under both irrigation regimes and L8 × L216 for better-parent heterosis under both irrigation regimes (Table-13).

For plant height, the highest negative significant cross combinations L19 × L216 for mid and L8 × Sakha 53 better -parents heterosis under normal irrigation treatment and L8 × Sakha 53 for mid and L19 × L216 for better -parents heterosis under water stress conditions. For stem diameter, the highest positive significant cross combinations L8 × Sakha 53 for mid-parent heterosis under normal irrigation and for better-parent heterosis under both irrigation treatments. This result is in contract with the results of Sultan, *et al.* (2009a), Sultan, *et al*, (2009b), Sultan, *et al.* (2010), Abd El-Satar, *et al.* (2015), ,Abd El-Satar (2017), Ahmed, *et al.* (2019), Abdelsatar, *et al.* (2020), Abdelsatar and Hassan (2020), Ibrahim, Suzan *et al.* (2021).

Table 12. Percentage of heterosis over mid (M.P) and better parent (B.P) in F1 crosses of studied sunflower for earliness and maturity traits under normal-watering (N) and moisture-stress (S) conditions.

Crosses	Days to 1st flower				Days to 50% flowering			
	Normal		W- Stress		Normal		W- Stress	
	MP	BP	MP	BP	MP	BP	MP	BP
L8 × L10	-10.44**	-6.99**	-12.69**	-9.30**	-6.58**	-6.29**	-12.34**	-10.60**
L8 × L19	-7.17**	-2.16*	-3.56**	-1.61*	-9.49**	-8.33**	-12.16**	-6.47**
L8 × Sakha 53	-9.15**	-4.96**	-6.35**	-4.07**	-2.97**	2.80**	-13.36**	-11.33**
L8 × L105	-10.81**	-7.04**	-10.51**	-10.16**	-7.01**	-5.19**	-10.16**	-7.43**
L8 × L216	-9.52**	-5.00**	-8.24**	-7.14**	-9.94**	-9.38**	-14.38**	-12.08**
L10 × L19	-7.09**	-5.76**	-13.31**	-8.06**	-11.11**	-10.26**	-9.66**	-5.76**
L10 × Sakha 53	-18.31**	-17.73**	-26.72**	-21.95**	-12.58**	-7.69**	-19.60**	-19.33**
L10 × L105	-9.47**	-9.15**	-13.86**	-10.16**	-7.99**	-6.49**	-11.04**	-10.14**
L10 × L216	-8.83**	-7.86**	-15.47**	-11.11**	-9.66**	-8.81**	-12.00**	-11.41**
L19 × Sakha 53	-8.57**	-7.91**	-9.31**	-8.94**	-2.34**	2.10*	-6.57**	-2.88**
L19 × L105	-6.05**	-5.04**	-9.52**	-8.06**	-6.45**	-5.84**	-6.62**	-3.60**
L19 × L216	-5.38**	-5.04**	-8.80**	-8.06**	-9.43**	-7.69**	-9.03**	-5.76**
Sakha 53 × L105	-10.95**	-10.64**	-12.35**	-10.57**	-2.36**	1.40	-12.08**	-11.49**
Sakha 53 × L216	-8.19**	-7.86**	-13.25**	-12.20**	0.33	6.99**	-11.04**	-10.74**
L105 × L216	-4.96**	-4.29**	-10.24**	-9.52**	-8.86**	-6.49**	-5.05**	-4.73**
LSD 5%	1.43	1.65	1.32	1.52	1.53	1.76	1.46	1.69
LSD 1%	1.91	2.20	1.76	2.03	2.04	2.36	1.95	2.26

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

Table-12. Continued

Crosses	Days to full flowering				Days to physiological maturity			
	Normal		W- Stress		Normal		W- Stress	
	MP	BP	MP	BP	MP	BP	MP	BP
L8 × L10	-7.69**	-4.29**	-8.39**	-4.29**	-5.93**	-4.29**	-2.02**	-5.75**
L8 × L19	-6.47**	-3.64**	-5.47**	-3.64**	-3.23**	-3.64**	-3.76**	-2.67**
L8 × Sakha 53	-9.51**	-8.72**	-9.43**	-8.72**	-4.92**	-8.72**	-4.74**	-4.20**
L8 × L105	-6.94**	-5.85**	-12.23**	-5.85**	-5.32**	-5.85**	-5.56**	-4.96**
L8 × L216	-6.98**	-5.33**	-8.23**	-5.33**	-5.82**	-5.33**	-5.01**	-4.20**
L10 × L19	-4.88**	-4.29**	-8.09**	-4.29**	-6.84**	-4.29**	-6.59**	-6.13**
L10 × Sakha 53	-17.61**	-15.34**	-17.72**	-15.34**	-6.26**	-15.34**	-8.76**	-5.36**
L10 × L105	-7.19**	-4.91**	-12.30**	-4.91**	-4.00**	-4.91**	-4.40**	-3.45**
L10 × L216	-9.04**	-7.36**	-10.19**	-7.36**	-7.52**	-7.36**	-5.05**	-5.75**
L19 × Sakha 53	-9.20**	-7.27**	-13.56**	-7.27**	-7.34**	-7.27**	-8.38**	-7.17**
L19 × L105	-6.55**	-4.85**	-11.32**	-4.85**	-5.86**	-4.85**	-8.41**	-5.68**
L19 × L216	-7.19**	-6.06**	-9.84**	-6.06**	-4.48**	-6.06**	-5.93**	-3.40**
Sakha 53 × L105	-7.29**	-7.02**	-12.62**	-7.02**	-3.77**	-7.02**	-5.47**	-3.41**
Sakha 53 × L216	-6.74**	-5.92**	-12.42**	-5.92**	-5.03**	-5.92**	-4.54**	-4.14**
L105 × L216	-6.47**	-5.92**	-11.46**	-5.92**	-5.42**	-5.92**	-4.55**	-4.17**
LSD 5%	1.47	1.69	1.19	1.69	1.53	1.69	1.28	1.77
LSD 1%	1.96	2.27	1.59	2.27	2.05	2.27	1.71	2.37

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

Table-12. Continued

Crosses	Days to full maturity			
	Normal		Stress	
	MP	BP	MP	BP
L8 × L10	-4.66**	-1.22	-4.41**	-3.50**
L8 × L19	-5.03**	-2.41**	-5.90**	-3.52**
L8 × Sakha 53	-3.47**	-3.21**	-4.25**	-1.77*
L8 × L105	-4.70**	-4.42**	-6.67**	-2.84**
L8 × L216	-6.37**	-4.82**	-6.49**	-5.56**
L10 × L19	-4.91**	-4.49**	-5.56**	-4.58**
L10 × Sakha 53	-3.69**	-6.53**	-5.01**	-3.18**
L10 × L105	-3.87**	-2.45**	-5.20**	-3.19**
L10 × L216	-4.18**	-4.08**	-4.28**	-3.85**
L19 × Sakha 53	-3.35**	-8.20**	-3.91**	-3.18**
L19 × L105	-1.77*	-8.24**	-2.61**	-1.42
L19 × L216	-4.90**	-4.80**	-5.42**	-4.23**
Sakha 53 × L105	-5.84**	-5.10**	-8.04**	-5.67**
Sakha 53 × L216	-3.33**	-3.20**	-4.49**	-2.47**
L105 × L216	-2.11**	-3.60**	-3.94**	-1.06
LSD 5%	1.42	1.48	1.10	1.64
LSD 1%	1.90	1.98	1.47	2.19

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

Table 13. Percentage of heterosis over mid-parent (M.P) and better parent (B.P) in F_1 crosses for yield and its components under normal-watering (N) and moisture-stress (S) conditions.

Crosses	No. of green leaves plant^{-1}				Plant height			
	Normal		W- Stress		Normal		W- Stress	
	MP	BP	MP	BP	MP	BP	MP	BP
L8 × L10	14.29**	-4.06**	15.92**	12.36**	-7.55**	13.75**	13.75**	-4.46
L8 × L19	22.45**	-5.20**	24.72**	12.15**	-7.32**	13.27**	13.27**	-5.43*
L8 × Sakha 53	-9.77**	-3.36**	-10.66**	-23.02**	-5.12*	-24.79**	-24.79**	-2.38
L8 × L105	17.86**	-5.62**	19.42**	-2.22**	-1.23	-2.38**	-2.38**	-0.05
L8 × L216	34.33**	-5.26**	37.70**	20.54**	-4.50*	22.33**	22.33**	-3.43
L10 × L19	-10.88**	-5.20**	-12.00**	-19.63**	-8.85**	-21.43**	-21.43**	-7.71**
L10 × Sakha 53	18.87**	-4.48**	21.65**	0.00	-5.37*	0.85	0.85	0.71
L10 × L105	8.60**	-4.49**	9.36**	-11.11**	-5.33*	-11.90**	-11.90**	-0.97
L10 × L216	36.36**	-3.38**	40.00**	20.54**	-7.53**	22.33**	22.33**	-3.34
L19 × Sakha 53	-7.30**	-3.73**	-7.91**	-14.29**	-2.54	-15.38**	-15.38**	2.38
L19 × L105	-8.26**	-2.25**	-8.93**	-17.78**	-7.42**	-19.05**	-19.05**	-4.39
L19 × L216	-12.33**	-4.89**	-13.43**	-14.29**	-11.89**	-15.53**	-15.53**	-9.07**
Sakha 53 × L105	-8.05**	-7.87**	-8.64**	-11.11**	-8.38**	-11.90**	-11.90**	-6.85**
Sakha 53 × L216	13.45**	-4.14**	14.55**	7.14**	-10.10**	7.69**	7.69**	-8.54**
L105 × L216	11.74**	-3.76**	12.66**	2.22**	-5.34*	2.38**	2.38**	-5.28*
LSD 5%	0.78	1.27	0.81	0.91	4.20	0.94	0.94	4.85
LSD 1%	1.05	1.70	1.09	1.21	5.62	1.26	1.26	6.49

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

Table 13. Continued

Crosses	Stem diameter			
	Normal		W- Stress	
	MP	BP	MP	BP
L8 × L10	19.56**	-7.63**	21.56**	16.27**
L8 × L19	16.19**	-6.51**	17.53**	8.43**
L8 × Sakha 53	36.69**	-2.97	37.19**	32.19**
L8 × L105	22.46**	-1.03	23.35**	18.68**
L8 × L216	-3.51**	-5.20*	-2.94**	-13.52**
L10 × L19	7.04**	-8.41**	13.41**	2.59**
L10 × Sakha 53	25.92**	-12.21**	27.17**	18.53**
L10 × L105	27.41**	-1.01	20.88**	26.97**
L10 × L216	11.61**	-5.50*	13.31**	2.61**
L19 × Sakha 53	22.29**	1.17	21.29**	10.64**
L19 × L105	26.37**	-5.54*	18.57**	21.53**
L19 × L216	1.73**	-8.11**	3.32**	-2.61**
Sakha 53 × L105	7.34**	-4.34	11.01**	0.70**
Sakha 53 × L216	8.79**	-5.15*	4.94**	-5.34**
L105 × L216	7.40**	-2.84	10.72**	-0.95**
LSD 5%	0.12	4.42	0.11	0.13
LSD 1%	0.15	5.92	0.15	0.18

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

CONCLUSION

The study generated more of promising combinations for increasing sunflower production under normal-watering and water stress conditions. Simultaneously, the study found that non-additive gene action governed studied traits, allowing selection in late segregating generations within created combinations to improve earliness and maturity as well as growth traits under wide a range of irrigation regimes.

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تقييم القدرة على التالف وقوة الهجين لصفات التبكير، النضج وصفات النمو لبعض التراكيب الوراثية من زهرة الشمس تحت ظروف الإجهاد المائي

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الملخص

تم تهجين ستة تراكيب وراثية متباينة من محصول زهرة الشمس باستخدام تصميم التزاوج النصف دائري لتحديد نوعي القدرة علي التآلف، وقوة الهجين تحت ظروف الري العادي والإجهاد المائي لصفات التبكير في النضج وكذلك صفات النمو، في قرية كفر المياسرة، مركز الزرقاء، محافظة دمياط، مصر خلال فصلي الصيف ٢٠١٩ و٢٠٢٠. تم تقييم الاباء وهجنها في الجيل الاول باستخدام تصميم القطاعات الكاملة العشوائية بثلاثة مكررات. أظهرت نسبة القدرة العامة إلى القدرة الخاصة على التآلف تحت ظروف الري العادي والإجهاد المائي تفوق تأثير الجينات غير المضيفة (السيادي والتفوقي) لجميع صفات التبكير والنضج بالإضافة إلى صفات النمو المدروسة. بالنسبة لعدد الأيام حتى النضج الكامل، سخا ٥٣ تحت الري العادي و L-105تحت ظروف الإجهاد المائي و L-216 تحت ظروف الري العادي و L-105 تحت ظروف الإجهاد المائي عدد الأوراق الخضراء كانت أفضل الاباء قدرة عامة علي التالف. وكانت التوليفات الناتجة سخا ٥٣ × السلالة ١٠٥ لصفة عدد الأيام حتى النضج الكامل، السلالة ١٠ × السلالة ٢١٦ لصفة عدد الاوراق الخضراء للنبات، والسلالة ٨ × سخا ٥٣ لقطر الساق تحت معاملتي الري العادي والجفاف حيث أظهرت تأثيرات قدرة خاصة علي التآلف مرغوبة بالإضافة إلى قوة الهجين لمتوسط الآباء و أفضل الآباء.