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DIALLEL CROSS ANALYSIS FOR SOME FLAX GENOTYPES UNDER NORMAL AND SALINE ENVIRONMENTS

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ABSTRACT

The present investigation was conducted using six flax genotypes with their 15 crosses in F_2 and F_3 generations grown under normal salinity (Etay El-Baroud Exp. Station, El-Beheira Governorate) and stress salinity soil conditions (Tag El-Ezz Exp. Station, El Dakahlia Governorates) to determine salinity tolerance and combining ability in these entries (parents and their crosses). In two seasons, 2005/06 and 2006/07, the six parents (P_1= S.413/3/3/1, P_2= S.400/4/4/2, P_3= S.402/1, P_4 = S.421/6/4/5, P_5 = Gentiana and P_6= Daniela) and their 15 progenies were evaluated in a randomized complete block design with three replications at the two above-mentioned locations.

The collected data indicated that additive effects were more important than non-additive effects for straw weight and its two important components (plant height and technical stem length) as well as for seed weight and its all components under the two environments in both generations. While, both non-additive and additive genetic effects play an important role in the inheritance of No. of basal branches per plant. The interaction of general (GCA) and specific (SCA) combining ability with environments indicated that both additive and non-additive genetic effects are influenced by environments. However, additive genetic effects were more influenced by environmental fluctuation than non-additive effects for straw weight per plant and its two important components. P_3 and P_6 showed high GCA effects for straw weight and its two important components in most cases. However, P_1 and P_3 showed high GCA effects for seed weight and its two important components (No. of capsules and 1000-seed weight). While, P_2 proved to be high general combiner for 1000-seed weight only. SCA effects indicated that the two crosses, $P_3 \times P_6$ and $P_5 \times P_6$ gave high SCA effects for straw weight, plant height and technical stem length, these crosses resulted from crossing between parents which one parent at least have high GCA effects for these traits. $P_1 \times P_2$ for seed weight per plant and $P_1 \times P_6$ for 1000-seed weight included high x low general combiner parents.

Concerning salinity tolerance, P_6 exhibited high yielding potential and low susceptibility to saline environments for straw weight and its two important components. Also, the cross P_3xP_6 showed high means for straw weight and its components, so it could be identified as low susceptible to salinity stress in both generations. The cross P_5xP_6 gave high yield potentiality and low susceptibility for straw weight and its two important components in F_3 only. The results indicated that tolerant parents could produce tolerant hybrids. Hence the two crosses, P_3xP_6 and P_5xP_6 may be useful as potential breeding material for developing genotypes tolerant to soil salinity for straw weight and its components. P_3 exhibited low or moderate susceptibility for seed weight and its two important components. However, P_5 and P_6 could be identified as high tolerant to salinity for No. of seeds per capsule. The two crosses P_1xP_2 and P_2xP_4 exhibited high or moderate tolerance for seed weight and its components. While, the cross P_3xP_5 exhibited high tolerance of salinity for both seed weight and No. of seeds per capsule.

Keywords: Flax, Diallel analysis, Gene action, Salinity tolerance.

INTRODUCTION

One of the earliest plants used in the manufacture of clothing is flax (*Linum usitatissimum* L.). Flax plant had been known since the dawn of civilization where it was cultivated as a crop for food and fiber. In Egypt, flax is one of the important oil and fiber crops (cultivated for two purposes). Flax has always had industrial uses; recently its uses have been widened to include a range of new products such as cigarette papers, car door panels and compressed boards. But more and more, flax is carving a niche as a health food. Alpha - linolenic acid (an omega-3 fatty acid found in flax) is essential for the human diet. It can reduce heart disease and lower cholesterol level.

Information on the relative importance of general (GCA) and specific (SCA) combining abilities is essential for flax breeder. Generally, GCA is associated with additive genes, while SCA is attributed primarily to non-additive (dominance and epistasis). It is very useful that the breeder should evaluate the potentialities of the available germplasm for new recombinations and eventually combining ability have proved to be of considerable use in crop plants. Information about combining ability and type of gene action for traits under saline conditions are necessary for flax breeder to design an appropriate breeding program for improving salinity tolerance. Published work on the combining ability and type of gene action of flax traits under salinity-stress conditions is generally lacking. On the other hand, many studies investigated combining ability in flax under normal conditions, *i.e.* Shehata and Comstock (1971), Foster *et al.,* (1998), Patil and Chopde (1981), Patil, *et al.,* (1997), Abo El-Zahab and Abo-Kaied (2000), Abo-Kaied (2002) and Abo-Kaied (2006).

A stress susceptibility index (S) proposed by Fisher and Maurer (1978) can be used as indicator for measuring salinity tolerance under stress conditions an could help for isolating improved tolerant genotypes (Winter *et al.*, 1988).

The present study aimed 1) to estimate combining ability of 21 flax entries (6 parents and their 15 crosses in F_2 and F_3 generations) under both saline and normal conditions, 2) to evaluate the influence of salinity stress on yield and yield components of these parents and their crosses and 3) to identify the best parents and crosses which could be recommended for breeding salinity tolerant flax lines.

MATERIALS AND METHODS

In an earlier study (Zahana,2006) fifteen hybrids derived from crossing six parental genotypes of flax, using a half diallel mating system, were utilized to estimate, combining ability and type of gene action in F_1 generation. The genotypes used included; four promising strains *i.e.,* S.413/3/3/1 (dual purpose), S.400/4/4/2, (oil type), S.402/1 (dual purpose) and S.421/6/4/5 (dual purpose) as well as two introductions *i.e.,* Gentiana (oil type) and Daniela (fiber type).

In the first season (2005/06), the F_1 seed bulks of the 15 diallel crosses were used to evaluate its F_2 progenies with the six parents at two locations viz: Etay El-Baroud Exp.Station, El-Beheira Governorate (clay, organic matter of 3.5%, available nitrogen 42.12 ppm, E.C. 1.91 and pH = 8.05) and Tag El-Ezz Exp.Station, El Dakahlia Governorates (clay, organic matter of 0.91%, available nitrogen 71.40 ppm, E.C. 11.3 and pH = 7.31).

In the second season (2006/07), the F_2 seed bulks of the 15 diallel crosses were used to evaluate the F_3 generations with the six parents at the previous experiment stations.

Each of the two experiments were laid out in a randomized complete block design with three replications with restricted randomization where each replicate consisted of 21 entries (6 parents and 15 crosses) and each entry was sown in one plot. Each plot consisted of three rows. Rows were 3 m long, spaced 20 cm apart. Single seeds were hand drilled at 5 cm spacing within rows. The normal cultural practices usually recommended for flax cultivation were applied at the proper time in both generations. Observations and measurements were recorded for each plot (parent or cross) on 20 guarded plants chosen at random from each plot for the following characteristics:

1- Straw weight per plant and its components:

(1)Straw weight/plant (g), (2) Plant height (cm), (3) Technical stem length (cm) and (4) No. of basal branches.

2- Seed weight per plant and its components:

(1) Seed weight/plant (g), (2) No. of capsules/plant, (3) 1000-seed weight (gm), and (4) No. of seeds/capsule.

Statistical manipulation of the data:

Plot means were used for statistical analysis. Data from each macro environment (combination of year and location) were analyzed and Barteltt's test for heterogeneity of error variances across environments indicated that error terms were homogeneous. In the combined analysis across environmental effect was assumed to be fixed.

Combining ability analysis:

Combining abilities, general (GCA) and specific (SCA) were calculated according to Griffing's method 2, model 1 (fixed effects). Forms of analysis for individual environments as given by Griffing (1956) and for combined analysis as suggested by Singh (1973).

Susceptibility analysis:

A stress - susceptibility analysis index (S) was used to characterize each genotype in the stress environments and the index was calculated using genotype means and a generalized formula (Fisher and Maurer 1978) in which

$S = (1-YS / YN) / D$, where YS = mean yield with stress environment, YN = mean yield with normal environment, and D = environment stress intensity = 1- (mean YS of all genotypes / mean YN of all genotypes).

The "S" was used to characterize the relative salinity stress tolerance of the various genotypes, where $S<0.50$ is indicated highly stress tolerant genotypes, $S>0.50<1.00$ designated moderately stress tolerant and $S>1.00$ referred to susceptible genotypes.

RESULTS AND DISCUSSION

1-Combining ability:

1-1-Straw weight per plant and its components :

Results presented in Table (1) show that mean square estimates of ordinary and combining ability analysis for straw weight and its components (plant height, technical stem length and No. of basal branches/plant) recorded in F_2 and F_3 generations under normal (E_1= Etay El-Baroud) and saline (E_2=Tag El-Ezz) environments and their combined data. Differences between the two environments were found to be highly significant for all studied traits. Also differences among genotypes, parents and crosses were highly significant for all traits at both environments and their combined analysis except parents in F_2 and F_3 at E_2 as well as crosses for No. of basal branches in F_3 at E_1 were not significant. This indicated that, under each environment, variability was existed among such populations and increase the chance of isolating good new recombinations in the following generations. Such result was confirmed by the genetic diversity between the parental genotypes and their crosses which clearly shown in Table (7). Mean squares due to general (GCA) and specific (SCA) combining ability were highly significant (or significant) for straw weight and its components in both generations (F_2 and F_3) under normal and salinity environments with exception No. of basal branches in F_2 and F_3 at E_1 was not significant. These results indicate that both additive and non-additive genetic effects were involved in the inheritance of straw weight and its components. However, the magnitude of mean squares due to GCA with that for SCA revealed that GCA/SCA ratio was more than unity for straw weight and its two important components (plant height and technical stem length) under the two environments in both generations and combined. While, the non-additive and additive genetic effects play an important role in the inheritance of No. of basal branches/plant. Therefore, the magnitude of additive genetic effects, must be of considerable value for each character. Consequently, effective selection could be possible within these F_2 and subsequent populations for straw weight/plant, plant height and technical stem length. Similar results were reported by Abo El-Zahab and Abo-Kaied (2000) and Abo-Kaied (2002).

The interaction between each of genotypes, parents, crosses and parent *vs.* crosses with environment was highly significant for all traits recorded, revealing inconsistent responses for these sources of variations from saline to normal conditions. The interaction mean squares of GCA with environments (E) were highly significant (or significant) in both generations for all characters with the exception of straw weight in F_3 and No. of basal branches per plant in F_2 only. Also, SCA x E mean squares were significant in most traits except plant height in F_3 and technical stem length in F_2 crosses. Hence, both additive and non-additive genetic effects are influenced by environments. However, the additive genetic effects were more influenced by environment than non-additive effects for straw weight/plant and its important components (plant height and technical stem length). These results are in agreement with reported by Patil and Chopde (1981) and Patil, *et al.,* (1997).

Table 1. Mean square of ordinary and combining ability analyses for straw weight and its components in F_2 and F_3 generations under normal (E_1) and saline (E_2) environments and their combined data (C.).

S.O.V	df S.	df C.	F_2 E_1	F_2 E_2	F_2 C.	F_3 E_1	F_3 E_2	F_3 C.	F_2 E_1	F_2 E_2	F_2 C.	F_3 E_1	F_3 E_2	F_3 C.
			Straw weight/plant (g)						Plant height/plant (cm)					
Environment (E)		1			54.08 **			104.09 **			4843.07 **			10771.10 **
Reps/ E		4			0.92 **			0.23 ns			31.85 **			253.61 *
Genotypes(G)	20	20	2.45 **	2.08 **	2.32 **	2.18 **	1.62 **	3.14 **	325.63 **	224.01 **	467.50 **	139.86 **	179.18 **	287.33 **
Parents (P)	5	5	6.02 **	2.21 **	2.36 **	2.24 **	1.58 **	3.66 **	516.92 **	337.43 **	793.09 **	146.00 **	237.53 **	341.99 **
Crosses(C.)	14	14	1.34 **	1.59 **	2.09 **	1.98 **	1.75 **	3.01 **	276.14 **	162.91 **	351.36 **	116.53 **	165.32 **	256.40 **
P.vs.C	1	1	0.16 ns	8.31 **	5.39 **	4.67 **	0.00	2.34 **	62.05 *	512.25 **	465.44 **	435.79 **	81.47 *	447.05 **
G x E		20			3.76 **			2.75 **		9.58	393.81 **			223.26 **
P x E		5			7.45 **			2.59 **			589.99 **			269.53 **
C x E		14			0.85 **			0.71 **			87.69 **			25.45 **
P vs C xE		1			6.67 **			3.89 **			419.15 **			368.24 **
GCA	5	5	1.14 **	1.30 **	0.98 **	1.55 **	1.66 **	3.12 **	364.19 **	141.41 **	457.87 **	125.53 **	160.47 **	269.19 **
SCA	15	15	0.71 **	0.49 **	0.70 **	0.45 **	0.17 **	0.36 **	23.33 **	52.42 **	55.15 **	20.32 *	26.14 **	37.97 **
GCA x E		5			1.46 **			0.10 ns			47.73 **			16.82 *
SCA x E		15			0.50 **			0.26 **			20.60 **			8.49 ns
Error	40	80	0.114	0.192	0.153	0.135	0.034	0.084	4.904	3.193	4.048	10.281	4.044	7.163
GCA/SCA			1.61	2.66	1.40	3.45	10.08	8.76	15.61	2.70	8.30	6.18	6.14	7.09
S.O.V	S.	C.	Technical stem length/plant (cm)						Number of basal branches/plant					
Environment (E)		1			4381.39 **			8133.27 **			3.30 **			3.09 **
Reps/ E		4			38.38 **			19.80 **			0.07 ns			0.08 *
Genotypes(G)	20	20	211.20 **	185.38 **	378.95 **	124.61 **	186.26 **	284.69 **	0.13 **	0.13 **	0.14 **	0.08 *	0.11 **	0.11 **
Parents (P)	5	5	368.36 **	317.73 **	655.82 **	144.23 **	186.67 **	316.07 **	0.24 **	0.06 ns	0.14 **	0.15 **	0.06 ns	0.09 **
Crosses(C.)	14	14	165.79 **	150.97 **	303.47 **	91.93 **	198.67 **	271.03 **	0.09 *	0.13 **	0.14 **	0.07 ns	0.10 **	0.11 **
P.vs.C	1	1	61.14 *	5.37 ns	51.38 **	484.06 **	10.60 ns	318.97 **	0.00 ns	0.56 **	0.31 **	0.00 ns	0.63 **	0.29 **
G x E		20			270.27 **			215.98 **			0.21 **			0.16 **
P x E		5			467.48 **			225.54 **			0.25 **			0.18 **
C x E		14			13.30 **			19.56 **			0.09 **			0.05 **
P vs C xE		1			49.39 **			388.34 **			0.46 **			0.53 **
GCA	5	5	221.80 **	185.72 **	393.09 **	113.41 **	191.91 **	292.58 **	0.02 ns	0.05 **	0.05 **	0.02 ns	0.05 **	0.03 *
SCA	15	15	19.94 **	20.49 **	37.39 **	17.58 **	18.81 **	29.00 **	0.05 **	0.04 **	0.05 **	0.03 **	0.03 **	0.04 **
GCA x E		5			14.42 **			12.75 **			0.03 ns			0.03 *
SCA x E		15			3.03 ns			7.39 *			0.04 **			0.03 **
Error	40	80	2.883	3.814	3.349	4.700	3.039	3.870	0.015	0.013	0.014	0.012	0.009	0.011
GCA/SCA			11.13	9.07	10.51	6.45	10.20	10.09	0.50	1.07	0.94	0.47	1.55	0.85

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

S. Single environment C. Comnined over all environments

Estimates of GCA effects (g_i) for six parents as affected by normal and saline environments and their combined data are presented in Table (2). P_6 (Daniela) and P_3 (S.402/1) were found to be high general combiners for straw weight and its two important components (plant height and technical stem length) at individual environments and combined in both generations except P_3 in F_2 only. Using such parents in hybridization programs may result in isolating desirable sergeants for the above-mentioned traits. However, P_2 (S.400/4/4/2) showed high g_i effect in saline environment and combined data only for No. of basal branches/plant. The correlation coefficient (r) between mean performance (Table 7) of parents and their GCA values (Table 2) was significantly positive at both environments and combined for straw weight, plant height and technical stem length, indicating that the superiority of a parent in cross combinations could be directly predicted its *per se* performance. In general, P_6 and P_3 were more efficient under both environments (normal and saline) as they possess favourable genes and yield improvement can be attained by their use in a breeding program at irrespective salinity conditions.

SCA effects (S_{ij}) for straw weight and its components in F_2 and F_3 crosses under both environments and their combined data are given in Table (3). The data indicated that there was no cross combination which was consistently good for all the straw weight per plant and its components. Out of the 15 F_2 and F_3 crosses, only one cross ($P_5 \times P_6$) exhibited significant positive SCA effects for straw weight, plant height and technical stem length, as well as $P_3 \times P_6$ indicated high SCA effect for the same traits except straw weight in F_2 only. For No. of basal branches/plant, one cross ($P_2 \times P_4$) showed significant positive SCA effects in F_2 and F_3 crosses under individual environment and combined. However, $P_1 \times P_5$ and $P_1 \times P_6$ crosses showed significant positive SCA effects at normal environment and combined in both generations. It could concluded that, the two crosses ($P_3 \times P_6$ and $P_5 \times P_6$) resulted from crossing between parents which one parent at least have high GCA effects for straw weight, plant height and technical stem length. Therefore, these crosses ($P_5 \times P_6$ and $P_3 \times P_6$) may prove useful for simultaneous improvement of these traits. The simple correlation (r) between cross means and their SCA values was significant and positive for all characters, indicating that high performing crosses were high specific combinations. Therefore, the choice of promising cross combination could be based on SCA effects or high mean performance in this case.

1-2-Seed weight per plant and its components :

Analysis of variance showed that mean squares due to genotypes, parents and crosses were highly significant for seed weight and its components viz., No. of capsules per plant, 1000-seed weight and No. of seeds per capsule for individual environments and combined data (Table 4). These results indicated that the parental genotypes and their F_2 and F_3 crosses showed reasonable degree of variability for these traits. Also, both mean squares due to GCA and SCA were highly significant for all characters. High ratio of GCA/SCA were also detected. These results revealed that the inheritance of these characters were mainly controlled by additive genetic effects of genes. Similar results were reported by Shehata and Comstock (1971), Patil and Chopde (1981) and Abo El-Zahab and Abo-Kaied (2000).

Table 2. Estimates of general combining ability effects($\hat{g}_i$) for six parental genotypes as affected by normal (E_1) and saline (E_2) environments and their combined data (C.) for staw weight and its combonents.

Parents	F_2 E_1	F_2 E_2	F_2 C.	F_3 E_1	F_3 E_2	F_3 C.
	Straw weight/plant (g)					
P1	-0.038 ns	0.002 ns	-0.018 ns	-0.163 ns	-0.308 **	-0.235 **
P2	-0.050 ns	-0.176 ns	-0.113 ns	-0.418 **	-0.391 **	-0.405 **
P3	0.180 ns	-0.508 **	-0.164 ns	0.505 **	0.406 **	0.456 **
P4	0.347 **	-0.208 ns	0.069 ns	-0.534 **	-0.400 **	-0.467 **
P5	-0.699 **	0.236 ns	-0.232 *	0.157 ns	0.009 ns	0.083 ns
P6	0.261 *	0.654 **	0.457 **	0.453 **	0.684 **	0.568 **
LSD **5%**	0.342	0.443	0.277	0.371	0.186	0.205
(Sij-Sik)**1%**	0.457	0.593	0.367	0.497	0.248	0.272
r	**0.985** **	**0.940** **	**0.940** **	**0.942** **	**0.910** **	**0.940** **
	Plant height/plant (cm)					
P1	-2.285 **	-3.564 **	-2.925 **	-2.064 ns	-3.425 **	-2.745 **
P2	-2.097 **	-0.796 ns	-1.447 **	-0.074 ns	-3.388 **	-1.731 **
P3	9.523 **	6.712 **	8.118 **	4.156 **	5.693 **	4.924 **
P4	-6.255 **	-0.898 ns	-3.577 **	-3.367 **	-1.036 ns	-2.201 **
P5	-6.059 **	-4.477 **	-5.268 **	-4.052 **	-3.465 **	-3.758 **
P6	7.173 **	3.023 **	5.098 **	5.401 **	5.621 **	5.511 **
LSD **5%**	2.238	1.806	1.423	3.240	2.032	1.892
(Sij-Sik)**1%**	2.994	2.416	1.885	4.335	2.719	2.508
r	**0.945** **	**0.860** **	**0.910** **	**0.960** **	**0.830** *	**0.900** **
	Technical stem length/plant (cm)					
P1	-1.635 **	-3.179 **	-2.407 **	-0.985 ns	-2.279 **	-1.632 **
P2	-2.771 **	-2.398 **	-2.585 **	-1.532 *	-3.537 **	-2.535 **
P3	6.885 **	6.811 **	6.848 **	3.420 **	6.290 **	4.855 **
P4	-4.847 **	-1.275 *	-3.061 **	-3.481 **	-2.542 **	-3.011 **
P5	-4.039 **	-5.089 **	-4.564 **	-3.207 **	-4.166 **	-3.686 **
P6	6.408 **	5.129 **	5.769 **	5.785 **	6.234 **	6.009 **
LSD **5%**	1.716	1.973	1.294	2.191	1.762	1.391
(Sij-Sik)**1%**	2.296	2.640	1.715	2.931	2.357	1.843
r	**0.934** **	**0.930** **	**0.930** **	**0.943** **	**0.900** **	**0.930** **
	Number of basal branches/plant					
P1	-0.067 ns	-0.033 ns	-0.050 ns	-0.048 ns	-0.013 ns	-0.030 ns
P2	0.050 ns	0.142 **	0.096 **	0.017 ns	0.137 **	0.077 **
P3	-0.017 ns	0.017 ns	0.000 ns	-0.004 ns	0.041 ns	0.018 ns
P4	0.042 ns	-0.008 ns	0.017 ns	0.047 ns	-0.026 ns	0.011 ns
P5	0.050 ns	-0.083 *	-0.017 ns	0.041 ns	-0.093 **	-0.026 ns
P6	-0.058 ns	-0.033 ns	-0.046 ns	-0.054 ns	-0.047 ns	-0.050 *
LSD **5%**	0.122	0.115	0.083	0.110	0.098	0.073
(Sij-Sik)**1%**	0.164	0.153	0.110	0.147	0.131	0.096
r	**0.702**	**0.920** **	**0.850** *	**0.742**	**0.950** **	**0.750** *

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

(P1= S.413/3/3/1 , P2= S.400/4/4/2, P3= S.402/1 , P4 = S.421/6/4/5, P5 = Gentiana and P6= Daniela)

Table 3: Estimates of specific combining ability ($\hat{s}_{ij}$) for 15 F_2 and F_3 crosses as affected by normal (E_1) and saline (E_2) environments and their combined (C.) data for staw weight and its combonents.

Parents	F_2 E_1	F_2 E_2	F_2 C.	F_3 E_1	F_3 E_2	F_3 C.	F_2 E_1	F_2 E_2	F_2 C.	F_3 E_1	F_3 E_2	F_3 C.
	Straw weight/plant (g)						Plant height/plant (cm)					
P1xP2	0.502 ns	0.101 ns	0.301 ns	1.049 **	0.108 ns	0.579 **	0.885 ns	-1.204 ns	-0.159 ns	3.589 ns	3.596 ns	3.592 ns
P1xP3	-0.149 ns	-0.400 ns	-0.274 ns	0.196 ns	-0.502 **	-0.153 ns	-4.269 *	1.121 ns	-1.574 ns	-3.044 ns	-2.035 ns	-2.540 ns
P1xP4	-0.432 ns	-0.610 ns	-0.521 ns	-0.039 ns	0.167 ns	0.064 ns	-4.557 *	-7.702 **	-6.129 **	0.421 ns	-2.813 ns	-1.196 ns
P1xP5	1.124 **	0.919 *	1.022 **	0.484 ns	-0.168 ns	0.158 ns	3.514 ns	10.144 **	6.829 **	0.463 ns	0.783 ns	0.623 ns
P1xP6	0.054 ns	0.438 ns	0.246 ns	-0.112 ns	0.597 **	0.243 ns	-3.119 ns	-4.423 **	-3.771 **	1.707 ns	0.096 ns	0.902 ns
P2xP3	-0.423 ns	0.204 ns	-0.110 ns	0.135 ns	0.344 *	0.239 ns	5.410 **	-1.867 ns	1.772 ns	-0.967 ns	0.748 ns	-0.110 ns
P2xP4	1.207 **	0.931 *	1.069 **	0.417 ns	-0.173 ns	0.122 ns	-3.144 ns	12.363 **	4.609 **	4.672 ns	-5.507 **	-0.418 ns
P2xP5	0.543 ns	-0.477 ns	0.033 ns	0.100 ns	-0.739 **	-0.320 ns	3.060 ns	5.309 **	4.184 **	1.771 ns	1.745 ns	1.758 ns
P2xP6	-1.257 **	-0.028 ns	-0.642 *	-0.710 *	0.037 ns	-0.336 ns	0.260 ns	6.142 **	3.201 *	0.238 ns	-2.278 ns	-1.020 ns
P3xP4	-0.737 *	1.193 **	0.228 ns	0.000 ns	0.183 ns	0.092 ns	1.601 ns	-1.012 ns	0.295 ns	1.335 ns	-1.454 ns	-0.059 ns
P3xP5	0.535 ns	0.316 ns	0.426 ns	-0.737 *	0.021 ns	-0.358 ns	-2.494 ns	3.801 *	0.653 ns	2.597 ns	2.188 ns	2.393 ns
P3xP6	-0.271 ns	0.255 ns	-0.008 ns	0.910 **	0.386 *	0.648 **	5.906 **	3.534 *	4.720 **	7.474 *	5.779 **	6.626 **
P4xP5	-1.001 **	-0.398 *	-0.699 *	-0.508 ns	-0.377 **	-0.442 *	2.388 ns	-5.123 ns	-1.367 ns	-1.140 ns	-0.050 ns	-0.595 ns
P4xP6	-0.244 ns	0.605 ns	0.180 ns	0.206 ns	-0.038 ns	0.084 ns	-3.915 ns	-1.523 *	-2.719 ns	-1.577 ns	-1.546 ns	-1.561 ns
P5xP6	1.028 **	0.397 *	0.713 **	1.192 **	0.153 **	0.673 **	7.889 **	7.490 **	7.689 **	7.412 *	11.536 **	9.474 **
LSD 5%	0.904	1.172	0.678	0.982	0.491	0.503	5.920	4.777	3.485	8.573	5.377	4.636
(Sij-Sik)1%	1.209	1.568	0.898	1.315	0.657	0.667	7.921	6.392	4.618	11.470	7.194	6.142
r	0.811 **	0.750 **	0.870 **	0.762 **	0.760 **	0.690 **	0.558 *	0.730 **	0.550 *	0.675 **	0.710 **	0.690 **
	Technical stem length/plant (cm)						Number of basal branches/plant					
P1xP2	2.562 ns	3.225 ns	2.893 *	3.703 ns	0.187 ns	1.945 ns	0.121 ns	-0.080 ns	0.021 ns	0.045 ns	0.003 ns	0.024 ns
P1xP3	-3.779 *	-5.264 **	-4.521 **	-1.910 ns	-1.924 ns	-1.917 ns	0.188 ns	0.112 ns	0.150 ns	0.153 ns	0.233 *	0.193 **
P1xP4	-5.003 **	-3.825 *	-4.414 **	0.588 ns	-2.271 ns	-0.842 ns	0.063 ns	-0.196 ns	-0.067 ns	-0.032 ns	-0.201 *	-0.116 ns
P1xP5	1.982 ns	2.563 ns	2.272 ns	2.484 ns	0.743 ns	1.613 ns	0.255 *	0.145 ns	0.200 *	0.211 *	0.133 ns	0.172 *
P1xP6	-1.185 ns	-3.736 *	-2.460 ns	1.149 ns	0.033 ns	0.591 ns	0.230 *	0.095 ns	0.163 *	0.249 *	0.087 ns	0.168 *
P2xP3	-1.999 ns	1.902 ns	-0.049 ns	2.357 ns	0.207 ns	1.282 ns	-0.129 ns	-0.263 *	-0.196 *	-0.042 ns	-0.150 ns	-0.096 ns
P2xP4	-0.757 ns	0.238 ns	-0.260 ns	-0.088 ns	-2.814 ns	-1.451 ns	0.213 *	0.362 **	0.288 **	0.203 *	0.283 **	0.243 **
P2xP5	4.261 **	0.312 ns	2.287 ns	2.908 ns	-1.506 ns	0.701 ns	0.005 ns	0.170 ns	0.087 ns	-0.021 ns	0.117 ns	0.048 ns
P2xP6	-0.595 ns	0.930 ns	0.167 ns	0.326 ns	-0.843 ns	-0.258 ns	-0.220 *	0.187 ns	-0.017 ns	-0.126 ns	0.104 ns	-0.011 ns
P3xP4	4.320 **	1.472 ns	2.896 *	0.773 ns	1.092 ns	0.933 ns	-0.387 **	0.154 ns	-0.117 ns	-0.312 **	0.113 ns	-0.100 ns
P3xP5	0.022 ns	-0.720 ns	-0.349 ns	3.662 ns	0.456 ns	2.059 ns	0.005 ns	0.229 *	0.117 ns	-0.029 ns	0.146 ns	0.058 ns
P3xP6	4.192 **	5.418 **	4.805 **	5.320 **	5.234 **	5.277 **	-0.087 ns	0.179 ns	0.046 ns	-0.008 ns	0.167 ns	0.079 ns
P4xP5	1.987 ns	-0.411 ns	0.788 ns	-0.377 ns	-3.225 ns	-1.801 ns	-0.120 ns	-0.080 ns	-0.100 ns	-0.034 ns	-0.021 ns	-0.028 ns
P4xP6	-4.886 **	-7.416 **	-6.151 **	-0.512 ns	-2.518 ns	-1.515 ns	0.055 ns	0.070 ns	0.063 ns	-0.129 ns	0.067 ns	-0.031 ns
P5xP6	8.222 **	8.085 **	8.154 **	5.911 **	11.040 **	8.475 **	-0.154 ns	-0.188 ns	-0.171 *	-0.163 ns	-0.133 ns	-0.148 *
LSD 5%	4.540	5.221	3.170	5.796	4.661	3.407	0.324	0.304	0.203	0.290	0.260	0.178
(Sij-Sik)1%	6.074	6.986	4.200	7.755	6.236	4.515	0.433	0.406	0.269	0.388	0.348	0.236
r	0.533 *	0.580 *	0.550 *	0.620 **	0.760 **	0.710 **	0.936 **	0.900 **	0.910 **	0.942 **	0.850 **	0.910 **

(P1= S.413/3/3/1, P2= S.400/4/4/2, P3= S.402/1, P4 = S.421/6/4/5, P5 = Gentiana and P6= Daniela)

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

r #: Simple correlation coefficients between SAC values and means of crosses.

Table 4. Mean square of ordinary and combining ability analyses for seed weight and its components in F_2 and F_3 generations under normal (E_1) and saline (E_2) environments and their combined data (C.).

	df		F_2			F_3			F_2			F_3		
S.O.V	S.	C.	E_1	E_2	C.	E_1	E_2	C.	E_1	E_2	C.	E_1	E_2	C.
			Seed weight/plant (g)						Number of capsules/plant					
Environment (E)		1			6.15 **			1.97 **			1256.16 **			1649.71 **
Reps/ E		4			0.21 *			0.03 *			78.04 **			42.39 *
Genotypes(G)	20	20	0.56 **	0.54 **	0.81 **	0.38 **	0.45 **	0.61 **	132.90 **	124.16 **	162.37 **	79.71 **	108.08 **	160.49 **
Parents (P)	5	5	0.70 **	0.27 *	0.63 **	0.52 **	0.17 **	0.49 **	165.51 **	44.85 *	84.54 **	86.66 **	54.56 *	123.43 **
Crosses(C.)	14	14	0.54 **	0.55 **	0.89 **	0.35 **	0.44 **	0.65 **	128.32 **	128.12 **	192.92 **	80.34 **	115.87 **	167.35 **
P.vs.C	1	1	0.12 ns	1.87 *	0.52 **	0.06 ns	1.87 **	0.63 **	34.09 ns	465.29 **	123.75 **	36.25 ns	266.68 **	249.79 **
G x E		20			0.84 **			0.62 **			202.95 **			134.30 **
P x E		5			0.76 **			0.53 **			182.19 **			100.07 **
C x E		14			0.20 **			0.15 **			63.52 **			28.86 **
P vs C xE		1			1.82 **			1.72 **			458.14 **			219.67 **
GCA	5	5	0.46 **	0.34 **	0.71 **	0.32 **	0.25 **	0.51 **	60.09 **	42.05 **	63.55 **	74.80 **	61.13 **	121.91 **
SCA	15	15	0.10 *	0.13 **	0.12 **	0.06 **	0.12 **	0.10 **	39.04 **	41.17 **	50.98 **	10.50 *	27.66 **	30.69 **
GCA x E		5			0.09 *			0.06 *			38.59 **			14.03 *
SCA x E		15			0.10 **			0.08 **			29.23 **			7.46 ns
Error	40	80	0.039	0.027	0.033	0.023	0.016	0.019	9.723	8.971	9.347	5.190	6.090	5.640
GCA/SCA			4.87	2.58	5.82	5.38	2.10	5.08	1.54	1.02	1.25	7.13	2.21	3.97
S.O.V	S.	C.	1000-seed weight (g)						Number of seeds/capsule					
Environment (E)		1			1.22 **			4.98 **			1.61 **			21.91 **
Reps/ E		4			0.06 ns			2.76 ns			0.40 ns			3.55 ns
Genotypes(G)	20	20	5.37 **	5.50 **	10.83 **	5.23 **	5.22 **	10.38 **	1.80 **	1.64 **	2.35 **	1.92 **	1.19 **	2.19 **
Parents (P)	5	5	9.00 **	8.94 **	17.92 **	9.94 **	8.23 **	18.10 **	2.09 **	4.12 **	5.16 **	2.47 **	3.43 **	5.17 **
Crosses(C.)	14	14	4.26 **	4.60 **	8.82 **	3.87 **	4.44 **	8.24 **	1.55 **	0.87 **	1.33 **	1.63 **	0.47 **	1.16 **
P.vs.C	1	1	2.67 **	0.95 *	3.41 **	0.66 **	1.04 **	1.68 **	3.86 **	0.13 *	2.69 **	3.37 **	0.01 ns	1.84 **
G x E		20			7.26 **			6.99 **			2.66 **			2.38 **
P x E		5			11.97 **			12.14 **			4.48 **			4.17 **
C x E		14			0.04 **			0.07 **			1.10 **			0.94 **
P vs C xE		1			2.49 **			1.14 **			3.09 **			2.76 **
GCA	5	5	6.10 **	6.45 **	12.54 **	6.19 **	6.13 **	12.31 **	0.49 **	1.28 **	1.66 **	1.08 **	0.84 **	1.88 **
SCA	15	15	0.35 **	0.30 **	0.63 **	0.26 **	0.28 **	0.51 **	0.64 **	0.31 **	0.49 **	0.50 **	0.25 **	0.35 **
GCA x E		5			0.01 ns			0.01 ns			0.11 ns			0.04 ns
SCA x E		15			0.02 **			0.03 **			0.45 **			0.39 **
Error	40	80	0.002	0.005	0.004	0.019	0.006	0.013	0.078	0.045	0.061	0.102	0.040	0.071
GCA/SCA			17.22	21.71	19.84	23.70	22.21	24.18	0.78	4.19	3.37	2.17	3.37	5.36

For expanation see Table (1) .

The interaction between each of genotypes, parents and crosses with environment was highly significant for seed weight and its components in both generations, revealing inconsistent responses for these sources of variations from saline to normal environments. GCA x E mean squares were highly significant (or significant) for seed weight and No. of capsules/plant in both generations. But GCA x E mean squares were not significant for 1000-seed weight and No. of seeds/capsule in both generations. On the other hand, variances due to SCA x E mean squares were significant for seed weight and its components in both generations except for No. of capsules/plant in F_3 only. This indicates that, both additive and non-additive genetic effects are influenced by environmental fluctuation for the previous characters, which were showed significant with environments. Also, significant GCA x E interaction means that selection in the succeeding generations must be practiced under the aimed environments. These results are in agreement with those reported by Patil and Chopde (1981) and Abo El-Zahab and Abo-Kaied (2000).

The estimates of GCA effects (g_i) for six parent as affected by normal (E_1) and saline (E_2) environments and their combined data for seed weight/plant and its components are shown in Table (5). P_1 (S.413/3/3/1) and P_3 (S.402/1) showed significant positive GCA effects for seed weight and its two important components (No. of capsules and 1000-seed weight) at both environments and combined data. Therefore, these parents (P_1 and P_3) could be used in single cross combination to produce progeny having good levels of seed weight suitable to normal or saline conditions. While, P_2 (S.400/4/4/2) was high general combiner for 1000-seed weight only. However, P_5 (Gentiana) and P_6 (Daniela) were high general combiners for No. of basal branches/plant at individual environments and combined. The simple correlation (r) between GCA values and parental means for seed weight/plant and all its components were significant except for No. of capsules/plant in E_1 and combined at F_2. These results indicated that the parents showing higher mean performance proved to be the highest general combiners for these traits under normal or saline conditions.

Specific combining ability effects (S_{ij}) for seed weight and its components in F_2 and F_3 crosses under both normal and saline environments and their combined data are given in Table (6). In general, the specific combining ability estimates indicated that there was no cross combination which was consistently good for all characters. Out of the 15 F_2 and F_3 crosses, two crosses ($P_1 \times P_2$ and $P_2 \times P_4$) showed significant positive SCA effects for seed yield/plant under two environments and combined data as well as, $P_1 \times P_6$ gave positive significant SCA effects for saline environment and combined analysis in both generations. Only one cross ($P_1 \times P_2$) for No. of capsules/plant, four crosses ($P_1 \times P_3$, $P_1 \times P_6$, $P_2 \times P_5$ and $P_2 \times P_6$) for 1000-seed weight and one cross($P_2 \times P_4$) for No. of seeds/capsule exhibited significant positive SCA effects under two environments and combined in both generations.

It could be noticed that, one cross ($P_1 \times P_2$) for seed weight/plant and one cross, ($P_1 \times P_6$) for 1000-seed weight included high x low general combiner parents. On the other hand, one cross (P_2xP_4) for seed weight/plant and No. of seeds/capsule included low x low general combiner parents. In such case (high x low combiners), desirable transgressive segregates might be expected in the subsequent generations if the additive genetic system was present in the good combiner and the complementary epistatic effects acted in the same direction to maximize seed weight/plant. These results are more or less in harmony with those previously obtained in F_1 generation (Zahana,2006). The simple correlation (r) between cross means and their SCA values was significant and positive for all traits under the two environments and combined in both generations, indicating that high performing crosses were high specific combinations for seed yield and its components.

Table 5. Estimates of general combining ability effects($\hat{g}_i$) for six parental genotypes as affected by normal (E_1) and saline (E_2) environments and their combined data (C.) for seed weight and its combonents.

Parents	F_2 E_1		F_2 E_2		F_2 C.		F_3 E_1		F_3 E_2		F_3 C.	
					Seed weight/plant (g)							
P1	0.132	*	0.136	*	0.134	*	0.102	*	0.074	*	0.088	**
P2	0.050	ns	0.123	*	0.087	ns	0.063	ns	0.084	*	0.074	*
P3	0.206	**	0.267	**	0.237	**	0.175	**	0.267	**	0.221	**
P4	0.214	**	-0.084	ns	0.065	ns	0.167	**	-0.066	ns	0.051	ns
P5	-0.283	**	-0.197	**	-0.240	ns	-0.238	**	-0.156	**	-0.197	**
P6	-0.318	**	-0.244	**	-0.281	**	-0.269	**	-0.202	**	-0.236	**
LSD **5%**	0.200		0.165		0.372		0.153		0.127		0.098	
(Sij-Sik)**1%**	0.267		0.221		0.493		0.205		0.170		0.130	
r	**0.775**	*	**0.970**	**	**0.890**	**	**0.796**	*	**0.960**	**	**0.860**	**
					Number of capsules/plant							
P1	1.639	*	2.486	*	2.063	**	1.033	*	1.772	*	1.403	*
P2	-0.869	ns	1.251	ns	0.191	ns	1.347	*	1.550	**	1.449	**
P3	1.367	*	3.297	*	2.332	*	1.845	*	2.215	**	2.030	**
P4	2.626	*	-2.256	ns	0.185	*	2.733	**	0.500	ns	1.617	**
P5	-2.804	**	-2.023	*	-2.414	**	-2.060	**	-0.942	ns	-1.501	**
P6	-2.159	*	-2.754	**	-2.457	**	-4.897	**	-5.094	**	-4.996	**
LSD **5%**	3.151		3.027		2.162		2.302		2.494		1.679	
(Sij-Sik)**1%**	4.216		4.049		2.864		3.080		3.336		2.225	
r	**0.649**		**0.950**	**	**0.600**		**0.934**	**	**0.770**	*	**0.880**	**
					1000-seed weight (g)							
P1	0.410	**	0.460	**	0.435	**	0.500	**	0.456	**	0.478	**
P2	0.644	**	0.662	**	0.653	**	0.617	**	0.653	**	0.635	**
P3	1.143	**	1.152	**	1.148	**	1.111	**	1.116	**	1.114	**
P4	-0.290	**	-0.309	**	-0.300	**	-0.269	**	-0.311	**	-0.290	**
P5	-0.858	**	-0.874	**	-0.866	**	-0.911	**	-0.853	**	-0.882	**
P6	-1.049	**	-1.091	**	-1.070	**	-1.048	**	-1.062	**	-1.055	**
LSD **5%**	0.050		0.068		0.042		0.140		0.078		0.079	
(Sij-Sik)**1%**	0.067		0.092		0.056		0.188		0.104		0.105	
r	**0.975**	**	**0.980**	**	**0.980**	**	**0.981**	**	**0.980**	**	**0.980**	**
					Number of seeds/capsule							
P1	-0.268	**	-0.395	**	-0.332	**	-0.307	**	-0.313	**	-0.310	**
P2	-0.126	ns	-0.329	**	-0.228	**	-0.282	**	-0.246	**	-0.264	**
P3	-0.201	*	-0.312	**	-0.257	**	-0.224	*	-0.266	**	-0.245	**
P4	-0.001	ns	0.138	ns	0.069	ns	-0.079	ns	0.085	ns	0.003	ns
P5	0.269	**	0.361	**	0.315	**	0.297	**	0.291	**	0.294	**
P6	0.328	**	0.536	**	0.432	**	0.596	**	0.450	**	0.523	**
LSD **5%**	0.282		0.214		0.175		0.322		0.202		0.188	
(Sij-Sik)**1%**	0.377		0.286		0.232		0.431		0.271		0.249	
r	**0.746**	*	**0.970**	**	**0.980**	**	**0.859**	**	**0.980**	**	**0.990**	**

For expanation see Table (2) .

Table 6: Estimates of specific combining ability ($\hat{s}_{ij}$) for 15 F_2 and F_3 crosses as affected by normal (E_1) and saline (E_2) environments and their combined (C.) data for seed weight and its combonents.

Crosses	F_2 E_1	F_2 E_2	F_2 C.	F_3 E_1	F_3 E_2	F_3 C.	F_2 E_1	F_2 E_2	F_2 C.	F_3 E_1	F_3 E_2	F_3 C.
	Seed weight/plant (g)						Number of capsules/plant					
P1xP2	0.196 *	0.455 **	0.326 **	0.172 *	0.298 *	0.235 *	9.219 **	12.071 **	10.645 **	5.720 **	9.134 **	7.427 **
P1xP3	0.364 *	0.159 ns	0.262 *	0.259 ns	0.161 ns	0.210 *	1.536 ns	-0.189 ns	0.674 ns	-0.135 ns	4.743 *	2.304 ns
P1xP4	0.081 ns	-0.255 ns	-0.087 ns	-0.009 ns	-0.242 *	-0.126 ns	4.494 ns	-6.522 *	-1.014 ns	2.081 ns	-1.216 ns	0.433 ns
P1xP5	-0.061 ns	-0.098 ns	-0.079 ns	-0.015 ns	-0.039 ns	-0.027 ns	-2.806 ns	-2.592 ns	-2.699 ns	-0.306 ns	-4.010 ns	-2.158 ns
P1xP6	-0.140 ns	0.715 **	0.287 *	-0.080 ns	0.727 **	0.324 **	-4.225 ns	11.102 **	3.439 ns	-0.729 ns	-1.028 ns	-0.879 ns
P2xP3	0.210 ns	-0.041 ns	0.085 ns	0.155 ns	0.102 ns	0.129 ns	3.735 ns	-1.021 ns	1.357 ns	3.720 ns	0.379 ns	2.049 ns
P2xP4	0.186 *	0.481 **	0.333 **	0.167 *	0.465 **	0.316 **	-0.811 ns	4.083 ns	1.636 ns	0.887 ns	2.646 ns	1.767 ns
P2xP5	0.165 ns	0.065 ns	0.115 ns	0.141 ns	0.095 ns	0.118 ns	-2.104 ns	0.244 ns	-0.930 ns	-1.964 ns	5.996 **	2.016 ns
P2xP6	-0.062 ns	-0.387 *	-0.224 ns	-0.044 ns	-0.332 **	-0.188 ns	-8.700 **	-7.582 **	-8.141 **	-4.327 *	-4.396 ns	-4.361 **
P3xP4	-0.557 **	0.145 ns	-0.206 ns	-0.433 **	0.145 ns	-0.144 ns	-8.227 **	1.050 ns	-3.589 ns	-3.242 ns	-4.359 ns	-3.800 *
P3xP5	-0.002 ns	0.361 *	0.179 ns	-0.012 ns	0.309 **	0.149 ns	6.534 *	5.677 *	6.105 **	1.948 ns	1.591 ns	1.769 ns
P3xP6	-0.146 ns	0.120 ns	-0.013 ns	-0.080 ns	0.085 ns	0.002 ns	-1.256 ns	2.644 ns	0.694 ns	2.191 ns	0.579 ns	1.385 ns
P4xP5	-0.011 ns	0.122 ns	0.056 ns	0.007 ns	0.092 ns	0.049 ns	4.724 ns	7.687 ns	6.206 **	3.947 ns	8.672 ns	6.310 **
P4xP6	-0.428 *	-0.055 **	-0.241 ns	-0.388 **	-0.072 **	-0.230 *	-6.981 *	0.735 *	-3.123 ns	-3.683 ns	-1.329 ns	-2.506 ns
P5xP6	-0.207 ns	-0.153 ns	-0.180 ns	-0.137 ns	-0.162 ns	-0.150 ns	-2.111 ns	-1.605 ns	-1.858 ns	1.087 ns	2.116 ns	1.602 ns
LSD **5%**	0.528	0.437	0.314	0.405	0.336	0.241	8.337	8.007	5.295	6.091	6.598	4.113
(Sij-Sik)**1%**	0.707	0.584	0.416	0.541	0.450	0.319	11.154	10.714	7.016	8.149	8.827	5.450
r	0.756 **	0.830 **	0.800 **	0.725 **	0.850 **	0.800 **	0.866 **	0.910 **	0.910 **	0.725 **	0.860 **	0.800 **
	1000-seed weight (g)						Number of seeds/capsule					
P1xP2	-0.500 **	-0.526 **	-0.513 **	-0.442 **	-0.415 **	-0.428 **	-0.731 **	-0.275 ns	-0.503 **	-0.803 **	0.094 ns	-0.355 ns
P1xP3	0.407 **	0.484 **	0.446 **	0.312 *	0.511 **	0.412 **	0.544 *	0.175 ns	0.359 *	0.414 ns	0.243 ns	0.329 ns
P1xP4	-0.023 ns	0.076 ns	0.026 ns	-0.148 ns	0.058 ns	-0.045 ns	-0.489 ns	0.625 **	0.068 ns	-0.203 ns	0.516 **	0.157 ns
P1xP5	0.108 *	0.101 ns	0.104 *	0.110 ns	0.080 ns	0.095 ns	0.340 ns	0.035 ns	0.187 ns	-0.099 ns	-0.016 ns	-0.058 ns
P1xP6	0.826 **	0.661 **	0.744 **	0.630 **	0.616 **	0.623 **	-0.552 *	-0.140 ns	-0.346 *	-0.218 ns	-0.172 ns	-0.195 ns
P2xP3	0.276 **	0.325 **	0.301 **	-0.172 ns	0.375 **	0.101 ns	-0.298 ns	-0.159 ns	-0.228 ns	-0.501 ns	0.016 ns	-0.242 ns
P2xP4	-0.108 *	0.053 ns	-0.027 ns	-0.122 ns	0.031 ns	-0.045 ns	0.802 **	0.991 **	0.897 **	0.605 *	0.852 **	0.729 **
P2xP5	0.953 **	1.012 **	0.983 **	0.900 **	0.950 **	0.925 **	0.232 ns	-0.599 **	-0.184 ns	0.326 ns	-0.590 **	-0.132 ns
P2xP6	0.742 **	0.572 **	0.657 **	0.713 **	0.536 **	0.624 **	1.473 **	0.340 *	0.566 **	1.363 **	-0.359 *	0.502 **
P3xP4	0.510 **	0.107 ns	0.309 **	0.448 **	0.091 ns	0.270 **	-0.589 *	0.208 ns	-0.191 ns	-0.823 **	0.155 ns	-0.334 ns
P3xP5	-0.589 **	-0.692 **	-0.640 **	-0.593 **	-0.673 **	-0.633 **	-0.860 **	0.718 **	-0.071 ns	-0.566 ns	0.626 **	0.030 ns
P3xP6	-0.067 ns	-0.181 **	-0.124 **	-0.030 ns	-0.187 **	-0.109 ns	-0.485 ns	-0.057 ns	-0.271 ns	-0.166 ns	-0.097 ns	-0.131 ns
P4xP5	-0.699 **	-0.647 **	-0.673 **	-0.680 **	-0.610 **	-0.645 **	-0.193 ns	-0.632 ns	-0.413 *	-0.107 ns	-0.545 ns	-0.326 ns
P4xP6	0.319 **	0.154 **	0.237 **	0.173 ns	0.159 *	0.166 *	-0.752 **	-0.707 **	-0.729 **	-0.630 *	-0.614 **	-0.622 **
P5xP6	-0.203 **	-0.331 **	-0.267 **	-0.128 ns	-0.305 ns	-0.217 **	-0.789 **	-0.264 **	-0.527 **	-0.786 **	-0.206 **	-0.496 **
LSD **5%**	0.133	0.181	0.103	0.371	0.206	0.194	0.746	0.566	0.429	0.852	0.535	0.461
(Sij-Sik)**1%**	0.178	0.242	0.137	0.497	0.275	0.258	0.999	0.757	0.569	1.141	0.716	0.611
r	0.487 *	0.510 *	0.500 *	0.381	0.530 *	0.450 *	0.912 **	0.580 *	0.640 **	0.803 **	0.580 *	0.500 *

For expanation see Table (3) .

2-Stress-susceptibility index (S):

2-1-Straw weight per plant and its components :

Salinity is one of the major limitations on crop productivity and crop quality. Hoorn *et al.,* (2002) has shown that the negative effects of high salinity are reducing the growth rate, as well as the plant biomass decreasing, plant stature, leaf area, and nutrient uptake as well as mineral disorders.

Mean performance for straw weight and its components recorded under normal and saline environments as well as their combined data and the susceptibility index (S) are shown in Table (7). S values for straw weight/plant revealed that out of the six genotypes used as parents, P_6 (Daniela) was identified as moderately tolerant genotype as well as high mean performance. Out of the 15 F_2 and F_3 crosses, four crosses (P_1xP_6, P_1xP_6, P_3xP_6 and P_4xP_6) were showed high or moderate tolerance to salinity in one or both generations as well as superiority for straw weight compared with other crosses, indicating that stress tolerance is due to high yielding potential and low or moderate susceptibility. However the cross P_2xP_6 revealed high tolerance with low of mean performance. In contrast, the cross P_2xP_4 had relatively high straw weight with high susceptibility. For plant height, P_3 (S.402/1) and P_4 (S.421/6/4/5) in both generations and P_6 (Daniela) in F_3 only showed moderate or high tolerance to salinity and high tallest than other parents. Out of the 15 F_2 and F_3 crosses, two crosses (P_3xP_6 and P_5xP_6) exhibited high tallest than other crosses but had low susceptibility. In addition, the two crosses (P_3xP_5 and P_3xP_4) showed moderate plant height with moderate tolerance to salinity. Also, for technical stem length, the above-mentioned parents (P_3 and P_6) and crosses (P_3xP_4, P_3xP_5, P_3xP_6 and, P_5xP_6) exhibited the same trend as plant height trait. Concerning No. of basal branches/plant, P_1(S.413/3/3/1) and P_2 (S.400/4/4/2) exhibited moderate stress tolerance. Two crosses (P_2xP_4 and P_3xP_6) gave high or moderately tolerance to salinity and had high or moderate No. of basal branches/plant.

In general, P_6 exhibited high yielding potential and low susceptibility for straw weight and its two important components (plant height and technical stem length). Also, the cross (P_3xP_6) had high mean performance for straw weight and its components although its low susceptibility in both generations. The cross P_5xP_6 gave high yield potential and low susceptibility in F_3 only for straw weight and its two important components. The results indicated that tolerant parents produced tolerant hybrids. Hence the two crosses (P_3xP_6 and P_5xP_6) identified as tolerant adapted crosses in both generations may be useful as potential breeding material for developing genotypes tolerant to salinity for straw weight and its components. Apparently, tolerance to salinity for straw weight and its components measured by susceptibility index (S), may be simple inherited and can be predicted for parental cross combination for potential parental performance and its tolerance to salinity.

Table 7: Mean performance for straw weight and its components recorded under normal and saline environments as well as their combined data and the susceptibility index (S)

	F_2				F_1				F_2				F_1			
genotype	E_1	E_2	C.	S	E_1	E_2	C.	S	E_1	E_2	C.	S	E_1	E_2	C.	S
Parents			**Straw weight/plant (g)**								**Plant height/plant (cm)**					
P1	5.69 d	4.78 b	5.24 c	0.46	4.81 c	3.39 d	4.10 c	1.17	103.83 b	86.13 cd	94.98 bd	1.15	94.73 a	75.27 bc	85.00 ab	1.23
P2	5.93 c	4.29 c	5.11 c	0.80	4.59 c	3.54 c	4.07 c	0.91	97.20 b	80.27 d	88.73 d	1.17	95.63 a	76.01 a	85.82 ab	1.22
P3	7.20 b	3.20 e	5.20 c	1.60	6.68 a	4.70 b	5.69 a	1.17	120.60 a	102.87 a	111.73 a	0.99	105.04 a	90.71 a	97.87 a	0.81
P4	7.61 a	3.73 d	5.67 b	1.47	4.82 c	3.43 d	4.12 c	1.14	95.93 b	91.93 bc	93.93 cd	0.28	91.84 a	85.55 a	88.69 ab	0.41
P5	5.10 e	3.80 d	4.45 d	0.73	5.97 b	4.68 b	5.33 b	0.86	85.33 c	72.47 e	78.90 e	1.01	86.77 b	66.90 c	76.84 b	1.37
P6	7.18 b	5.48 a	6.33 a	0.68	6.09 b	4.91 a	5.50 b	0.77	115.47 a	92.67 bc	104.07 a	1.33	103.60 a	86.38 a	94.99 a	0.99
Mean	**6.45**	**4.21**	**5.33**		**5.49**	**4.11**	**4.80**		**103.06**	**87.72**	**95.39**		**96.27**	**80.14**	**88.20**	
Crosses																
P1xP2	6.73 b	4.93 de	5.83 c-e	1.49	6.39 ab	3.52 i	4.96 de	1.38	101.13 c-f	86.67 de	93.90 ef	1.22	101.88 ab	78.72 b-e	90.30 b	1.19
P1xP3	6.31 df	4.10 f	5.20 f	1.96	6.46 a	3.70 q	5.08 cd	1.31	107.60 b-e	96.50 bc	102.05 b-d	0.88	99.47 ab	82.17 b-d	90.82 b	0.91
P1xP4	6.19 eq	4.19 f	5.19 f	1.81	5.19 fq	3.57 hi	4.38 f	0.96	91.53 q	80.07 f	85.80 q	1.07	95.42 b	74.66 de	85.04 b	1.14
P1xP5	6.70 bc	6.16 a	6.43 b	0.45	6.40 ab	3.64 qh	5.02 d	1.32	99.80 e-q	94.33 bc	97.07 de	0.47	94.77 b	75.83 de	85.30 b	1.05
P1xP6	6.59 bc	6.10 a	6.34 b	0.42	6.10 cd	5.08 b	5.59 a	0.51	106.40 c-e	87.27 de	96.83 de	1.53	105.47 ab	84.23 bc	94.85 ab	1.06
P2xP3	6.02 q	4.52 b	5.27 f	1.39	6.15 bc	4.47 cd	5.31 b	0.84	117.47 ab	96.28 bc	106.87 b	1.54	103.54 ab	84.99 bc	94.26 ab	0.94
P2xP4	7.82 a	5.55 b	6.68 a	1.62	5.39 f	3.14 k	4.27 fq	1.28	102.13 c-f	93.90 c	98.02 c-e	0.69	101.66 ab	72.00 e	86.83 b	1.53
P2xP5	6.11 fq	4.59 e	5.35 f	1.39	5.76 e	2.99 i	4.38 f	1.48	99.53 e-q	92.27 cd	95.90 d-f	0.62	98.07 ab	76.83 c-e	87.45 b	1.14
P2xP6	5.45 h	5.27 bc	5.36 f	0.18	5.25 fq	4.44 d	4.84 e	0.47	109.97 bc	100.60 ab	105.28 bc	0.73	105.99 ab	81.89 b-d	93.94 b	1.19
P3xP4	6.10 fq	5.48 b	5.79 de	0.57	5.90 c-e	4.30 f	5.10 cd	0.83	109.50 b-d	97.03 bc	103.27 bc	0.97	102.55 ab	85.14 b	93.84 b	0.89
P3xP5	6.33 df	5.05 cd	5.69 e	1.13	5.85 de	4.54 c	5.20 bc	0.68	105.60 c-e	98.27 bc	101.93 b-d	0.59	103.13 ab	86.35 b	94.74 ab	0.85
P3xP6	6.48 cd	5.40 bc	5.94 cd	0.93	7.79 a	5.58 a	6.69 a	0.87	127.23 a	105.50 a	116.37 a	1.46	117.46 a	99.03 a	108.24 a	0.82
P4xP5	4.96 l	4.63 e	4.80 q	0.37	5.04 q	3.34 j	4.19 q	1.03	94.70 fq	81.73 ef	88.22 fq	1.17	91.87 b	77.38 c-e	84.63 b	0.83
P4xP6	6.68 bc	6.05 a	6.37 b	0.52	6.05 cd	4.35 e	5.20 bc	0.86	101.63 c-f	92.83 cd	97.23 c-e	0.74	100.88 ab	84.97 bc	92.93 b	0.83
P5xP6	6.90 bc	6.29 a	6.60 a	0.49	7.73 a	4.95 b	6.34 a	1.10	113.63 ab	98.27 bc	105.95 bc	1.15	109.19 ab	95.63 a	102.41 a	0.65
Mean	**6.36**	**5.22**	**5.79**		**6.10**	**4.11**	**4.68**		**105.86**	**93.43**	**92.58**		**102.09**	**82.65**	**85.54**	
Parents			**Technical stem length/plant (cm)**								**Number of basal branches/plant**					
P1	91.59 b	77.51 cd	84.55 c	1.30	85.43 bc	71.39 b	78.41 b	1.15	1.07 d	1.20 b	1.14 e	0.35	1.21 d	1.15 b	1.18 e	0.16
P2	84.87 c	72.25 d	78.56 c	1.26	82.74 c	69.65 b	76.19 bc	1.10	1.73 b	1.40 a	1.57 a	0.62	1.62 c	1.40 a	1.51 a	0.47
P3	104.54 a	92.57 a	98.55 a	0.97	92.14 a	84.38 a	88.26 a	0.59	1.80 a	1.13 c	1.47 b	1.19	1.73 b	1.13 b	1.43 b	1.17
P4	84.62 c	82.77 bc	83.70 c	0.18	83.25 bc	74.12 b	78.69 b	0.76	1.80 a	1.13 c	1.47 b	1.19	1.87 a	1.13 b	1.50 a	1.34
P5	75.83 d	65.26 r	70.55 d	1.18	76.70 d	62.25 c	69.47 c	1.31	1.73 b	1.00 e	1.37 c	1.36	1.72 b	1.00 d	1.36 c	1.43
P6	102.09 a	88.97 ab	95.53 b	1.09	95.88 a	80.33 a	88.10 a	1.13	1.60 c	1.07 c	1.33 d	1.07	1.60 c	1.07 c	1.33 d	1.13
Mean	**90.59**	**79.89**	**85.24**		**86.02**	**73.69**	**79.85**		**1.62**	**1.16**	**1.39**		**1.63**	**1.15**	**1.39**	
Crosses																
P1xP2	90.30 c-e	78.00 c-e	84.15 c-q	1.03	91.59 c-q	68.71 c	80.15 b-e	1.31	1.73 c	1.33 e	1.53 c	1.19	1.63 d	1.43 c	1.53 d	0.73
P1xP3	93.62 b-d	78.72 c-e	86.17 c-e	1.21	90.93 d-h	76.42 b	83.68 b-d	0.84	1.73 c	1.40 d	1.57 b	0.99	1.72 b	1.57 a	1.64 b	0.53
P1xP4	80.66 q	72.07 e	76.37 h	0.81	86.53 fh	67.24 c	76.89 de	1.17	1.67 d	1.07 i	1.37 d	1.86	1.59 e	1.07 h	1.33 h	1.95
P1xP5	88.45 d-f	74.65 de	81.55 d-h	1.18	88.70 d-h	68.63 c	78.67 c-e	1.19	1.87 b	1.33 e	1.60 b	1.48	1.82 a	1.33 e	1.58 c	1.60
P1xP6	95.73 bc	78.57 c-e	87.15 c-e	1.36	96.35 b	78.32 b	87.34 b	0.98	1.73 c	1.33 e	1.53 c	1.19	1.77 b	1.33 e	1.55 d	1.46
P2xP3	94.26 b-d	86.67 b	90.46 c	0.61	94.65 bc	77.30 b	85.97 bc	0.96	1.53 f	1.20 q	1.37 d	1.12	1.59 e	1.33 e	1.46 e	0.96
P2xP4	83.77 fq	76.92 c-e	80.34 f-h	0.62	85.30 qh	65.44 c	75.37 e	1.22	1.93 a	1.80 a	1.87 a	0.36	1.89 a	1.70 a	1.79 a	0.59
P2xP5	89.60 d-f	73.18 e	81.39 e-h	1.39	88.57 d-h	65.13 c	76.85 de	1.39	1.73 c	1.53 b	1.63 b	0.60	1.66 c	1.47 b	1.56 c	0.68
P2xP6	95.19 bc	84.01 bc	89.60 c	0.89	94.98 bc	76.19 b	85.59 bc	1.04	1.60 e	1.40 d	1.50 c	0.65	1.56 e	1.40 d	1.48 e	0.60
P3xP4	98.50 b	87.36 b	92.93 b	0.86	91.12 c-q	79.18 b	85.15 bc	0.69	1.47 q	1.27 f	1.37 d	0.71	1.45 f	1.33 e	1.39 q	0.48
P3xP5	95.01 bc	81.35 b-d	88.18 cd	1.09	94.28 b-d	76.92 b	85.60 bc	0.97	1.67 d	1.47 c	1.57 b	0.62	1.63 d	1.40 d	1.51 d	0.83
P3xP6	109.63 a	97.71 a	103.67 a	0.82	104.93 a	92.09 a	98.51 a	0.64	1.47 q	1.47 c	1.47 c	0.00	1.55 e	1.47 b	1.51 d	0.33
P4xP5	85.25 e-q	73.58 e	79.41 qh	1.04	83.34 h	64.40 c	73.87 e	1.19	1.60 e	1.13 h	1.37 d	1.51	1.67 c	1.17 q	1.42 f	1.80
P4xP6	88.82 d-f	76.79 c-e	82.81 d-h	1.03	92.20 b-e	75.51 b	83.85 b-d	0.95	1.67 d	1.33 e	1.50 c	1.04	1.48 f	1.30 f	1.39 q	0.73
P5xP6	102.74 a	88.48 b	95.61 a	1.05	98.89 a	87.44 a	93.17 a	0.61	1.47 q	1.00 l	1.24 e	1.66	1.44 f	1.03 h	1.24 l	1.69
Mean	**92.77**	**80.54**	**80.28**		**92.16**	**74.60**	**77.17**		**1.66**	**1.34**	**1.42**		**1.63**	**1.36**	**1.41**	

Means identified by the same letter are not significantly different at 0.05 level of probability according to FLSD.

(P1= S.413/3/3/1 , P2= S.400/4/4/2, P3= S.402/1 , P4 = S.421/6/4/5, P5 = Gentiana and P6= Daniela)

2-2-Seed weight per plant and its components:

Table (8) shows mean performance of six parents and their 15 F_2 and F_3 crosses for seed weight and its components under normal and saline environments as well as their combined data and the susceptibility index (S). out of six genotypes used as parents, P_6 (S.400/4/4/2) was identified as high tolerant with moderate of seed weight in both generations. However, P_3 (S.402/1) gave high seed yield with moderate tolerance in both generations. While, P_5 (Gentiana) was identified as moderately tolerant with low seed weight/plant. Out of 15 crosses, three crosses (P_3xP_4, P_3xP_5 and P_3xP_6) had high tolerance but not possess high mean of seed weight per plant, followed by two crosses (P_2xP_4 and P_1xP_2) identified as high yield potential and low or moderate susceptibility. For No. of capsules/plant, P_1 (S.413/3/3/1), P_2 (S.400/4/4/2) and P_3 (S.402/1) exhibited low or moderate of both stress tolerance and capsules number/plant, but P_4 only had high capsules number/plant with low susceptibility. The cross P_3xP_6 is considered the best cross because it is own moderate No. of capsules/plant with high tolerance in F_2 generation. However the cross P_2xP_4 exhibited moderate of both capsules number/plant and susceptibility in F_3 generation. While, the cross P_2xP_5 was identified as high tolerant over both generations but not possess high of capsules number/plant. Concerning 1000-seed weight, P_3 exhibited high and moderate tolerance over F_2 and F_3, respectively. The two crosses, P_1xP_3 and P_2xP_3 identified as highly stress tolerate over generations coupled with high of 1000-seed weight. On the other hand, four crosses (P_1xP_2, P_1xP_4, P_2xP_4 and P_2xP_5) had low susceptibility, but had not possess high yield potential for 1000-seed weight. For No. of seeds/capsule, three parental genotypes, P_2, P_5 and P_6 had low or moderate susceptibility over both generations, only two parents (P_5 and P_6) of them possessed high No. of seeds/capsule. Out of 15 crosses, five crosses (P_1xP_2, P_1xP_4, P_2xP_4, P_3xP_4 and P_3xP_5) had low susceptibility over all generations, while two crosses (P_2xP_4 and P_3xP_5) of them own high No. of seeds/capsule. Although, the cross P_2xP_6 possessed higher seeds number/capsule than other crosses but exhibited high susceptibility. However, two crosses (P_2xP_3 and P_5xP_6) exhibited low susceptibility only in F_3 generation.

It can be concluded that, P_3 exhibited low or moderate susceptibility to salinity for seed weight and its two important components, No. of capsules/plant and 1000-seed weight. However, P_5 and P_6 had high No. of seeds/capsule with high tolerance to salinity. Out of 15 F_2 and F_3 crosses, two crosses (P_1xP_2 and P_2xP_4) exhibited high or moderate tolerant for seed weight and its components. While, the cross P_3xP_5 exhibited high tolerance to salinity for both seed weight and No. of seeds/capsule. However, P_1xP_4 had high or moderate tolerance for both 1000-seed weigh and No. of seeds/capsule.

Table 8: Mean performance for seed weight and its components recorded under normal and saline environments as well as their combined data and the susceptibility index (S)

	F_2				F_1				F_2				F_1			
genotype	E_1	E_2	C.	S	E_1	E_2	C.	S	E_1	E_2	C.	S	E_1	E_2	C.	S
Parents	Seed weight/plant (g)								Number of capsules/plant							
P1	1.91 c	1.21 c	1.56 c	0.91	1.57 c	0.97 c	1.27 c	1.05	31.26 b	23.81 ab	27.54 a	0.67	24.85 b	18.60 a	21.73 b	0.67
P2	1.62 e	1.39 b	1.50 c	0.36	1.36 d	1.13 b	1.24 c	0.46	29.68 b	24.38 ab	27.03 a	0.50	24.78 b	17.09 a	20.93 b	0.83
P3	2.35 b	1.59 a	1.97 a	0.80	1.93 b	1.41 a	1.67 a	0.75	30.06 b	26.29 a	28.18 a	0.35	27.55 b	19.83 a	23.69 a	0.75
P4	2.66 a	1.04 d	1.85 b	1.51	2.19 a	0.95 c	1.57 b	1.56	44.74 a	19.74 bc	32.24 a	1.58	33.57 a	17.66 a	25.62 a	1.27
P5	1.36 c	0.89 e	1.12 e	0.87	1.06 e	0.82 d	0.94 e	0.63	24.36 c	17.02 c	20.69 b	0.85	19.63 c	9.80 b	14.71 c	1.34
P6	1.72 c	0.82 f	1.27 d	1.30	1.35 d	0.75 e	1.05 d	1.23	39.41 a	17.62 c	28.52 a	1.56	19.04 c	10.71 b	14.87 c	1.17
Mean	**1.94**	**1.16**	**1.55**		**1.58**	**1.01**	**1.29**		**33.25**	**21.48**	**27.36**		**24.90**	**15.61**	**20.26**	
Crosses																
P1xP2	2.25 d	2.14 a	2.19 b	0.23	1.86 c	1.73 cd	1.80 cd	0.54	42.08 a	41.58 a	41.83 a	0.08	33.20 a	32.32 a	32.76 a	0.11
P1xP3	2.57 a	1.99 b	2.28 a	1.11	2.06 a	1.78 b	1.92 a	1.05	34.83 b	30.37 bc	32.60 b-d	0.86	28.85 b-d	26.60 b	27.72 bc	0.31
P1xP4	2.30 cd	1.22 l	1.76 d	2.29	1.79 d	1.04 i	1.42 q	3.20	42.85 a	20.48 fq	31.67 b-e	3.51	32.95 a	19.92 de	26.44 bc	1.58
P1xP5	1.66 h	1.27 h	1.46 h	1.15	1.38 q	1.16 h	1.27 h	1.23	28.12 c-e	23.64 d-f	25.88 ef	1.07	24.77 fq	15.69 f-h	20.23 ef	1.46
P1xP6	2.04 e	1.54 f	1.79 d	1.20	1.98 a	1.88 a	1.93 a	0.40	37.34 ab	36.61 ab	36.98 ab	0.13	21.51 q	14.52 f-h	18.01 fq	1.30
P2xP3	2.34 b	1.78 d	2.06 c	1.18	1.92 b	1.73 cd	1.83 c	0.76	34.52 b-d	28.30 b-d	31.41 b-e	1.21	32.02 ab	23.01 b-d	27.51 bc	1.12
P2xP4	2.32 cd	1.95 c	2.13 b	0.79	1.92 b	1.76 bc	1.84 bc	0.65	35.03 b	29.85 bc	32.44 b-d	1.00	31.07 a-c	24.56 bc	27.82 bc	0.84
P2xP5	1.80 f	1.42 q	1.61 f	1.04	1.49 f	1.30 q	1.40 q	0.99	26.31 ef	25.24 c-f	25.78 ef	0.27	27.43 d-f	26.47 b	26.95 bc	0.14
P2xP6	1.54 l	0.92 k	1.23 i	1.98	1.28 h	0.83 k	1.05 i	2.71	20.36 f	16.69 q	18.53 q	1.21	17.23 h	11.93 h	14.58 q	1.23
P3xP4	1.76 q	1.74 e	1.75 e	0.08	1.64 e	1.62 e	1.63 e	0.07	28.05 c-e	27.86 b-e	27.96 c-f	0.05	28.44 c-e	16.22 e-q	22.33 de	1.71
P3xP5	1.86 f	1.80 d	1.83 c	0.16	1.75 d	1.70 d	1.73 d	0.25	35.38 b	31.72 b	33.55 bc	0.70	27.84 d-f	20.73 cd	24.28 cd	1.02
P3xP6	1.61 h	1.57 f	1.59 f	0.12	1.45 f	1.43 f	1.44 fq	0.14	28.24 c-e	27.96 b-e	28.10 c-f	0.07	25.24 e-f	15.57 f-h	20.41 ef	1.53
P4xP5	1.79 q	1.27 h	1.53 q	1.43	1.46 f	1.15 h	1.31 h	1.66	38.63 ab	30.18 bc	34.41 b	1.47	31.72 a-c	27.10 b	29.41 b	0.58
P4xP6	1.34 j	1.05 j	1.19 j	1.07	1.04 i	0.94 j	0.99 j	0.74	27.57 de	22.50 e-q	25.04 ef	1.24	21.26 q	12.94 qh	17.10 fq	1.56
P5xP6	1.06 k	0.84 l	0.95 f	1.02	0.88 j	0.76 l	0.82 k	1.10	25.01 ef	19.39 fq	22.20 fq	1.51	20.23 qh	14.95 f-h	17.59 fq	1.04
Mean	**1.88**	**1.50**	**1.63**		**1.59**	**1.39**	**1.44**		**32.29**	**27.49**	**28.41**		**26.92**	**20.17**	**22.37**	
Parents	1000-seed weight (g)								Number of seeds/capsule							
P1	8.47 b	8.38 c	8.43 c	0.63	8.73 c	8.05 c	8.39 c	1.38	7.23 d	6.10 d	6.67 e	1.43	7.23 d	5.60 d	6.42 d	1.48
P2	8.66 b	8.47 b	8.57 b	1.43	8.75 b	8.13 b	8.44 b	1.27	7.33 d	6.63 c	6.98 c	0.87	6.33 e	6.06 c	6.20 e	0.28
P3	10.14 a	10.07 a	10.11 a	0.44	10.20 a	9.73 a	9.97 a	0.81	7.77 c	6.03 d	6.90 d	2.04	7.77 c	5.56 e	6.66 c	1.87
P4	7.48 c	7.37 a	7.42 d	0.91	7.58 d	7.07 d	7.33 d	1.19	7.93 c	7.13 c	7.53 c	0.92	7.81 c	6.55 c	7.18 c	1.06
P5	6.56 d	6.39 e	6.47 e	1.62	6.33 e	6.13 e	6.23 e	0.55	8.50 b	8.19 b	8.35 b	0.33	8.60 b	7.51 b	8.06 b	0.84
P6	5.25 e	5.14 f	5.20 f	1.33	5.18 f	5.03 f	5.11 f	0.53	9.53 a	8.93 a	9.23 a	0.58	8.80 a	8.18 a	8.49 a	0.46
Mean	**7.76**	**7.64**	**7.70**		**7.80**	**7.36**	**7.58**		**8.05**	**7.17**	**7.61**		**7.76**	**6.58**	**7.17**	
Crosses																
P1xP2	8.61 e	8.46 e	8.53 e	0.58	8.63 d	8.25 e	8.44 d	0.89	6.20 l	6.10 h	6.15 l	0.28	6.15 i	6.09 h	6.12 i	0.09
P1xP3	10.02 b	9.96 b	9.99 b	0.20	9.88 a	9.64 b	9.76 a	0.49	7.40 f	6.57 q	6.98 q	1.92	7.28 e	6.22 q	6.75 q	1.40
P1xP4	8.15 i	8.09 q	8.12 h	0.27	8.04 h	7.76 q	7.90 q	0.70	7.57 e	7.47 c	7.52 d	0.23	6.88 f	6.85 b	6.86 fq	0.05
P1xP5	7.72 i	7.55 j	7.63 k	0.72	7.66 j	7.24 k	7.45 j	1.10	7.67 d	7.10 e	7.38 e	1.26	7.28 e	6.52 d	6.90 ef	1.02
P1xP6	8.24 h	7.89 h	8.07 i	1.41	8.04 h	7.57 i	7.81 h	1.18	7.15 q	7.10 e	7.13 f	0.12	7.46 de	6.52 d	6.99 d-f	1.22
P2xP3	10.12 a	10.00 a	10.06 a	0.39	9.75 a	9.70 a	9.73 a	0.10	6.70 h	6.30 h	6.50 h	1.02	6.39 h	6.06 h	6.23 i	0.49
P2xP4	8.30 q	8.27 f	8.29 f	0.14	8.18 q	7.93 f	8.06 e	0.62	8.00 b	7.90 a	7.95 b	0.21	7.64 b-d	7.25 a	7.44 b	0.49
P2xP5	8.80 d	8.66 d	8.73 d	0.51	8.56 e	8.31 d	8.44 d	0.60	7.70 d	6.53 q	7.12 f	2.59	7.73 b	6.01 h	6.87 fq	2.16
P2xP6	8.39 f	8.00 h	8.20 q	1.53	8.24 f	7.69 h	7.96 f	1.36	9.00 a	6.97 f	7.98 a	3.86	9.07 a	6.40 e	7.74 a	2.85
P3xP4	9.42 c	8.81 c	9.12 c	2.13	9.25 c	8.46 c	8.85 c	1.73	7.16 q	7.13 e	7.15 f	0.06	6.57 q	6.53 d	6.55 h	0.05
P3xP5	7.75 k	7.45 k	7.60 l	1.30	7.56 k	7.15 l	7.36 k	1.11	7.88 c	7.87 b	7.87 c	0.03	7.25 e	7.21 a	7.23 c	0.05
P3xP6	8.08 j	7.74 i	7.91 j	1.39	7.99 i	7.43 j	7.71 i	1.43	7.33 f	7.27 d	7.30 f	0.15	7.60 b-d	6.65 c	7.12 cd	1.22
P4xP5	6.21 n	6.03 m	6.12 n	0.95	6.10 m	5.79 n	5.94 m	1.03	7.40 f	6.97 f	7.18 f	1.00	7.50 cd	6.39 f	6.95 ef	1.44
P4xP6	7.04 m	6.61 l	6.83 m	1.98	6.81 l	6.35 m	6.58 l	1.39	7.14 q	7.07 e	7.10 fq	0.17	7.28 e	6.48 de	6.88 fq	1.07
P5xP6	5.95 o	5.56 o	5.76 o	2.15	5.87 n	5.34 o	5.61 n	1.83	7.73 d	7.13 d	7.43 e	1.33	7.50 cd	7.09 ab	7.30 bc	0.53
Mean	**8.19**	**7.94**	**7.68**		**8.04**	**7.64**	**7.47**		**7.47**	**7.03**	**6.75**		**7.31**	**6.55**	**6.44**	

Means identified by the same letter are not significantly different at 0.05 level of probability according to FLSD.
(P1= S.413/3/3/1 , P2= S.400/4/4/2, P3= S.402/1 , P4 = S.421/6/4/5, P5 = Gentiana and P6= Daniela)

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تحليل الهجن التبادلية لبعض التراكيب الوراثية في الكتان تحت ظروف البيئة العادية والملحية

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أجريت هذه الدراسة بهدف تقدير القدرة علي الائتلاف والفعل الجيني لمحصولي القش والبذرة ومكوناتهما في الكتان تحت ظروف البيئة العادية والملحية من خلال تقييم 15 هجين ناتجة من التهجين بين ستة أباء (1= س1/3/3/413، 2= س2/4/4/400، 3= س 1/402، 4= س 5/4/6/421، 5= جنتيانا ، 6= دانيال) باستعمال نظام التزاوج النصف دائري . تم تقييم الـ6 آباء، 15 هجين في الجيلين الثاني والثالث في في محطتي البحوث الزراعية بكل من ايتاي البارود- م البحيرة (بيئة عادية) وتاج العز- م الدقهلية (بيئة ملحية) في موسمين متتاليين (2005/2006- 2006/2007) في تجربة قطاعات كاملة العشوائية ذات ثلاث مكررات . وتشير النتائج إلى أن تأثير العوامل الوراثية المضيفة أكبر من الغير مضيفة في توريث صفات وزن القش وأهم مكونين (الطول الكلي والطول الفعال) وكذلك لصفات وزن البذور ومكوناته في كل من الجيلين الثاني والثالث تحت ظروف البيئة العادية والملحية ، بينما تأثير كل من العوامل المضيفة والغير مضيفة له نفس الأثر في توريث صفة عدد الأفرع القاعدية للنبات، كما تشير نتائج التفاعل بين كلا من القدرة العامة والقدرة الخاصة على الائتلاف مع البيئة أن كلا من العوامل المضيفة والغير مضيفة قد تأثرت بالظروف البيئية، بينما كان تأثر العوامل المضيفة بالظروف البيئية أكبر من الغير مضيفة لصفات وزن القش للنبات وأهم مكوناته. كما تشير النتائج إلى أن الأبويين س 1/402، دانيال أظهرا قدرة عامة عالية علي الائتلاف لمعظم صفات محصول القش ومكوناته ماعدا صفة عدد الأفرع القاعدية للنبات ، كذلك الأبويين س1/3/3/413، س 1/402 أظهرا قدرة عامة عالية علي الائتلاف لصفات محصول البذرة ووزن الألف بذرة وعدد الكبسولات/نبات بينما الأب س2/4/4/400 لصفة وزن الألف بذرة فقط. كما تشير نتائج القدرة الخاصة على الائتلاف أن الهجينين (3 x 6 ، 5 x 6) أظهرا قدرة خاصة على الائتلاف لصفات وزن القش ،والطول الكلي ،والطول الفعال وأن أب واحد على الأقل كان له قدرة عالية عامة على الائتلاف لتلك الصفات، بينما الهجين 1×2 أظهر قدرة خاصة على الائتلاف لوزن البذور وكذلك الهجين (1×6) لوزن الألف بذرة وأن اباء هذين الهجينين عبارة عن (عالي ×منخفض) للقدرة العامة على الائتلاف.

كما تشير النتائج الخاصة بتحمل الملوحة أن الأب دانيال أظهر حساسية منخفضة للملوحة مع محصول عالي من وزن القش والطول الكلي والطول الفعال ، كذلك الهجين (3×6) أعطى محصول عالي من وزن القش ومكوناته بالإضافة الى حساسية منخفضة للملوحة في كل من الجيل الثاني والثالث ، كذلك الهجين (5×6) أعطى محصول عالي من القش والطول الكلي والطول الفعال مع حساسية منخفضة للملوحة وذلك في الجيل الثالث فقط ، ويستنتج من ذلك أن الآباء المتحملة للملوحة أعطت هجن متحملة للملوحة. لذلك فان هذان الهجينان (3×6 ، 5×6) والتي صنفت على أنها متحملة للملوحة من المحتمل أن تكون مفيدة كمواد تربية نحصل منها على تراكيب وراثية عالية في محصول القش ومكوناته ومتحملة للملوحة. كما أظهرا الأبوان جنتيانا ودانيال تحمل عالي للملوحة مع قدرة محصولية عالية لصفة عدد البذور بالكبسولة. بينما الهجينين (1×2 ، 2×4) أظهرا قدرة عالية أو متوسطة لتحمل الملوحة لصفات محصول وزن البذور ومكوناته، بينما (3×5) أظهر تحمل عالي للملوحة لكل من صفتي وزن البذور وعدد البذور بالكبسولة.