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TOLERANCE OF SOME FLAX VARIETIES to SOIL SALINITY

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ABSTRACT

Two field experiments were conducted at the experimental farm of Sakha Agricultural Research Station during 2010/2011 and 2011/2012 seasons. The objectives of this investigation were to study the tolerance of some flax **(*Linum ustitissimum*)** varieties to different soil salinity levels and soil properties. Seven flax varieties i.e. Sakha 1 , Sakha 2 , Sakha101 , Sakha 102 ,Eclena ,Elona and Esclena, were grown under three soil salinity levels where: EC values were namely, (S_1 2: < 4), (S_2 4: < 6) and (S_3 6: < 8) dSm^{-1}. Split plots design was used, where the flax varieties were allocated in sub plot whereas the main plots were assigned to the salinity levels with four replicates.

The obtained results can be summarized as follow:

Soluble cations and anions of soil paste extract after harvesting of flax greatly increased with increasing salinity levels. Slight difference between before and after harvesting for soil paste extracts. Total nitrogen, available phosphorus and available potassium increased with increasing soils salinity. Soil salinity significantly affected flax yield and yield components. Flax seed yield (kg /fed.) had the following sequence at the salinity level: Sakha 1 = Sakha 2 > Sakha101 = Sakha 102 = Eclena = Elona > Esclena; at S_1; Sakha 1> Sakha 2 =Sakha101 = Sakha 102 = Eclena = Elona=Esclena at S_2 and Sakha 1 = Sakha 2 > Sakha101 = Eclena = Elona >Esclena=Sakha102at S_3.

The used varieties were arrangedin the descending order according toStraw yield (ton/fed.) as follows:

With S_1: Sakha1 = Sakha2 =Esclena= Eclena = Elona.>Sakha101=sakha102
With S_2: Sakha1 = Esclena=Eclena = Elona > Sakha2 =Sakha101=Sakha102
WithS_3:=Sakha1= Esclena=Eclena = Elona =Sakha101=Sakha102 > Sakha2

Fiber weight (kg/fed)-technical stem length and radius (cm) significantly decreased with increasing soil salinity levels.

Flax varieties Sakha 1 and Sakha2 were the more tolerant varieties to soil salinity. Whereas the varieties Eclena and Esclena was the most sensitive one to soil salinity. The varieties Sakha101, Sakha 102 were of moderate tolerant to soil salinity.

Keywords: Flax, soil salinity, yield and yield components.

INTRODUCTION

Flax is the second fiber crop after cotton in our country with regard to the cultivated area and economic importance. Now it could be considered as a versatile crop, however flax fiber can be exploited to produce many different products, it is the raw materials of textile, twines and different kinds of paper especially bank note. For its importance it is considered an important crop in our economic policy through its local fabrications as well as exportation El Hariril, *et al* (2010).

Soil salinity is one of the most important environmental factors affecting the growth and yield of most field crops, especially in arid and semi-arid regions as in Egypt. Saline soil is wide-spread in the Northern part of the country especially in Kafr El-Sheikh Governorate. The problem of salinity received much attention in Egypt in both old cultivated and newly reclaimed areas. Effects on growth and yield may be due to ionic imbalances which can be caused by high salt concentration and soluble salts which depress the water potential of nutrient medium and hence restrict water uptake by plant roots. The management of salt affected soils requires a good understanding of crop- salinity relations, particularly under field condition. Salinity seriously constrains crop yield in irrigated agriculture throughout the world. Nearly one third of the world's irrigated agricultural land is saline, and salt-affected soil estimates by about 400-950 × 10^6 ha, (Shannon, 1984). Salinity is one of the major problems that face the farmers all over the world. More than 25% of irrigated land is saline in Egypt, Iran, Iraq, India, Pakistan and Syria (Choukr-Allah, 1996). Increasing soil salinity in Egypt is very alarming problem. Soil salinity inhibits plant growth as a result of stomata closure, which reduces the CO_2 fixation as a result the rate of leaf elongation enlargement and cells division were reduced. Furthermore salt in soil water solution can reduce evapotranspiration by making soil water less available for plant root extraction, (Shalhevet, 1994). Leaching salts from the soil by increasing irrigation amount is a practice used in Egypt to improve growth and yield of crops grown under saline conditions, Katerji *et al*., (2000), Mass and Hoffman (1977) and Schleiff (2008) evaluated the relative salt tolerance of agricultural crops and obtained relationships between relative yield and soil salinity. They concluded that the yield decreased approximately linearly as salinity increased beyond the threshold salinity level. Mohamedin *et al.,* (2004) and Atwa *et al*., (2008) , El- Sanafawy *et al.,* (2011) conducted pots experiments to study on the role of irrigation water salinity on the studied varieties of flax to achieve the principal knowledge about sensitivity and tolerance of these varieties to salinity. They found that flax Sakha1 and Sakha 2 were the highest tolerant varieties to irrigation water salinity.

The objective of the present study is to apply results of pot experiments on the field scale aiming at selecting strains more tolerant to salinity stress. Therefore this research was conducted to study the effect of three levels of soil salinity under field conditions on some flax varieties and soil chemical properties

MATERIALS AND METHODS

Two field experiments were conducted at the experimental farm of Sakha Agricultural Research Station during two successive seasons of 2010/2011 and 2011/2012 to study the effect of three levels of soil salinity (S1 2: <4), (S_2 4: <6) and (S_3 6 :<8) dS/m on yield and yield components characteristics of seven flax varieties i.e Sakha 1, Sakha 2, Sakha 101, Sakha 102, Esclena, Eclena and Elona. The experiments were conducted in split plot design with four replicates. The main plots were assigned to soil salinity levels and sub plots were randomly assigned to flax varieties,

The land was prepared for planting and divided into 84 plots; each plot was 3m in length and 3 m in width and irrigated to distribute salinity in each plot. Then, it was left for ten days after which six samples for each plot at depths of 0-30 and 30-60 cm were taken. These samples were air dried, ground, analyzed before planting. A map was drawn for salinity distribution (average 0-60 cm) for every season. The soil under study is surrounded by buildings from three sides while the fourth side was limited by main drain. So, the drainage was restricted.

Seeds were sown on 25th of November and harvested, in May 15th in both seasons. The experiments plots were treated with 15.5% kg P_2O_5/fed as super phosphate fertilizer) in one dose before sowing. Nitrogen was applied at rate of 60 kg N/fed, using urea 46.5% N, in two equal doses the first dose after one month of planting whears the second dose at second irrigation . Potassium fertilizer was added in form of potassium sulphate (48% K_2O) at rate of 24 K2O kg/fed after one month of planting.

The other agricultural practices were carried out as recommended in the area. Soil samples were analyzed for ECe, total N%, available P and K and soluble ions, according to standard methods of Page ***et al*.,** (1982) and Piper (1950). Soil chemical and physical properties of the experimental sites are shown in Table (1). Representative samples of flax varieties were taken at harvesting to determine the following characteristics: Seed yield (kg/fed.), straw yield (ton/fed.), weight of 1000 seed (g), technical stem length cm, radius (mm), and fiber, weight kg/fed., Data were subjected to statistical analysis according to Gomez and Gomez (1984) for all studied characters by using Irristat (Computer Program Duncan's 1955).

Table (1): Some chemical and physical properties of the soil (0 - 60cm) before experiment in both seasons 2010/2011 and 2011/2012.

Season	pH 1;2.5	EC_e, dSm^{-1}	Soluble ions, meq / L								SAR
			Cations, meq/L				Anions, meq/L				
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3^{-}	Cl^{-}	SO_4^{2-}	
2010/2011	7.80	2: <4 (S1)	7.40	5.20	15.24	2.16	0.2	2.80	15.30	11.70	6.07
	7.90	4: <6 (S2)	12.50	9.40	24.40	3.70	0.4	3.70	23.40	22.50	7.37
	8.10	6: <8 (S3)	16.70	14.60	34.40	4.30	0.4	3.80	34.1	31.70	8.69
2011/2012	7.82	2: <4 (S1)	7.50	5.90	14.20	2.20	0.3	3.80	13.50	12.20	5.48
	7.95	4: <6 (S2)	14.00	9.00	22.50	4.50	0.5	3.50	22.0	24.00	6.64
	8.11	6: <8 (S3)	18.00	14.00	33.10	4.90	0.6	4.50	32.00	32.90	8.28

Season	EC_e, dSm^{-1}	Total N %	Available		O.M %	Particle size distribution %			
			P, mg kg^{-1}	K, mg kg^{-1}		Clay	Silt	sand	Texture
2010/2011	2: <4 (S1)	0.10	6.90	310	1.25	54.5	21.9	23.6	Clayey
	4: <6 (S2)	0.10	7.0	330	1.30				
	6: <8 (S3)	0.09	7.1	350	1.20				
2011/2012	2: <4 (S1)	0.11	7.0	320	1.15				
	4: <6 (S2)	0.14	7.1	340	1.25				
	6: <8 (S3)	0.15	7.2	360	1.25				

RESULTS AND DISCUSSION

3.1. Soil chemical properties after harvesting:

Data presented in Table (2) show that soluble cations and anions of soil paste extract after harvesting of flax greatly increased with increasing salinity levels slight difference between before and after harvesting for soil paste extracts. This may be due to the restricted drainage of the soil under study. Total nitrogen (%) and available phosphorus and potassium (mg kg^{-1}) increased with increasing soil salinity levels. This may be due to limited growth of the plants under salinity and stunted, which reduced elements consumption, in addition to the limited amounts of organic matter decayed under saline condition.

3.2 : Crop yields :

Data in Table (3and 4) and Figs. (1and 2) show that, increasing soil salinity reduced all the studied crop characteristics.

3.2.1: Seed yield (kg /fed.)

Esclena,Eclena and Elona,flax genotypes appeared to be more sensitive to high soil salinity (S_3) as compared with the other studied varieties (Table, 3 and Fig., 1) The maximum seed yield (kg/fed.) (665.0, 652.5), (648.0, 648.8) and (545,560) (kg/fed.) were obtained with Sakha1, Sakha2 and Sakha101 at S_1 in the first and second seasons, respectively.

Also the mean values of flax seed yield (kg/fed.) were (522.5, 522.5) and (501.3, 487.5)) at S_2 with Sakha 1and Sakha 2. While the mean values of seed yield (kg /fed.) were (400.0, 392.5) (375.0, 381.3)) with Sakha 1, and Sakha 2 at S_3 in both seasons, respectively.

Table (2): Some chemical properties of soil samples (0-60 cm) after harvesting of flax in 2010/2011 and 2011/2012 seasons.

Season	pH	EC_e, dSm^{-1}	Soluble ions, meq / L								SAR	N%	avabile	
			Cations, meq/L				Anions, meq/L						P	K
			Ca^{2+}	Mg^{2+}	Na^+	K^+	CO_3^{2-}	$HCO3_3^-$	Cl^-	SO_4^{2-}	SAR		ppm	
2010	7.90	2: <4 (S1)	6.90	5.00	14.40	2.70	0.2	3.00	13.80	12.00	5.90	.12	7.17	332
	8.00	4: <6 (S2)	12.60	7.60	25.60	3.20	0.4	2.85	23.40	22.35	8.05	.15	7.2	340
	8.10	6: <8 (S3)	15.90	14.5	32.80	5.80	0.4	5.00	30.10	33.50	8.41	.16	7.2	370
2011	7.92	2: <4 (S1)	7.90	4.40	14.70	3.00	0.3	3.80	13.80	12.10	5.93	.13	7.2	340
	8.06	4: <6 (S2)	12.70	8.00	26.20	3.10	0.5	2.70	24.30	22.50	8.14	.16	7.3	350
	8.15	6: <8 (S3)	16.90	14.9	33.60	4.60	0.6	3.70	32.70	33.00	8.43	.17	7.3	380

The used varieties were arranged according to seed yield (kg/fed.) as follow:
WithS_1: Sakha1 = Sakha2 >Sakha101=Sakha102 =Esclena= Eclena = Elona.
With S_2: Sakha1 = Sakha2 > Esclena=Eclena = Elona Sakha101=Sakha102
WithS_3:=Sakha1= Sakha2 > Elona=Sakha101 = Eclena= Sakha102> Esclena

The sequences indicate that the sensitive flax varieties to salinity levels were Esclena and Sakha102. Similar results were obtained by El- Sanafawy *et al*. (2011).

3.2.2: flaxstraw yield (ton/fed.):

Data in Table (3) and Fig. (2) show that the decrease in flax straw yield due to salinity stress scince it was less than the corresponding occurred on seed yield. The maximum mean values of straw yield (4.075, 4.085) and

(3.758, 3.771) ton /fed were product with Sakha 1and Sakha2 at S_1 in the two seasons, respectively. While the mean values of straw yield at S_2 were (3.653, 3.662), and (3.4, 3.375) (4.125, 3.360) with Sakha 1, Esclena and Elona in both seasons, respectively.

Also, at S_3 the mean values were(3.2,3.21) (3.425, 3.375) and (3.375, 3.435) with Sakha1, Esclena and Elona in both seasons respectively. The used varieties were arrangedin the descending order according toStraw yield (ton/fed.) as follows:

With S_1: Sakha1 = Sakha2 =Esclena= Eclena = Elona.>Sakha101=sakha102
With S_2: Sakha1 = Esclena=Eclena = Elona > Sakha2 =Sakha101=Sakha102
WithS_3:=Sakha1= Esclena=Eclena = Elona =Sakha101=Sakha102 > Sakha2

Table (3): Effect of soil salinity levels (s), flax varieties (v) and (s x v) interaction on seed and straw yields during the two growing seasons

Variety	First season			Mean	Second season			Mean
	S1	S2	S3		S1	S2	S3	
	Flax Seed yield kg/fed.							
Sakha1	652.5a	522.5a	400.0a	526.3	665.0a	522.5a	392.5a	526.7
Sakha2	648.0a	487.5b	381.3a	505.8	648.8a	501.3a	375.0a	508.3
Sakha101	560.0bc	392.5c	271.3bc	407.9	545.0b	380.0b	267.5bc	397.5
Sakha 102	550.0bc	406.3c	257.5cd	404.6	533.8b	405.0b	261.3bc	400.0
Esclena	537.5c	390.0c	242.5d	390.0	532.5b	397.5b	237.5c	389.2
Ecalena	572.5b	415.0c	272.5bc	420.0	560.0b	397.5b	267.5bc	408.3
Elona	557.5bc	412.5c	290.0b	420.0	542.5b	410.0b	275.0b	409.2
Mean	583.2	432.3	302.1	439.2	575.4	430.5	296.6	434.2
	Flax Straw yield (ton/Fadden)							
Sakha1	4.075a	3.653 a	3.200ab	3.642	4.085 a	3.662ab	3.210 a	3.652
Sakha2	3.758 ab	2.450 b	2.490 b	2.899	3.771ab	3.457 d	2.500 b	3.242
Sakha101	3.185 b	2.725 b	2.900ab	2.937	3.222bc	2.735cd	2.910ab	2.955
Sakha 102	3.060 b	2.890 b	3.250ab	3.067	3.056c	3.100bc	3.260 a	3.138
Esclena	3.600 ab	3.400 a	3.425 a	3.475	3.610abc	3.375ab	3.160ab	3.381
Ecalena	3.640 ab	3.753 a	2.775ab	3.389	3.647abc	3.385 b	2.785ab	3.272
Elona	3.675 ab	4.125 a	3.375 a	3.725	3.260bc	3.360 b	3.435 a	3.351
Mean	3.570	3.285	3.059	3.304	3.521	3.296	3.037	3.284

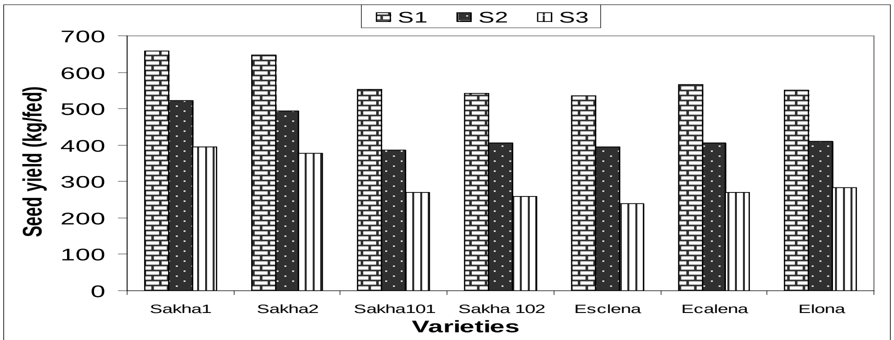

Fig (1): Effect of soil salinity levels (dS/m) on seed yield of flax varieties.

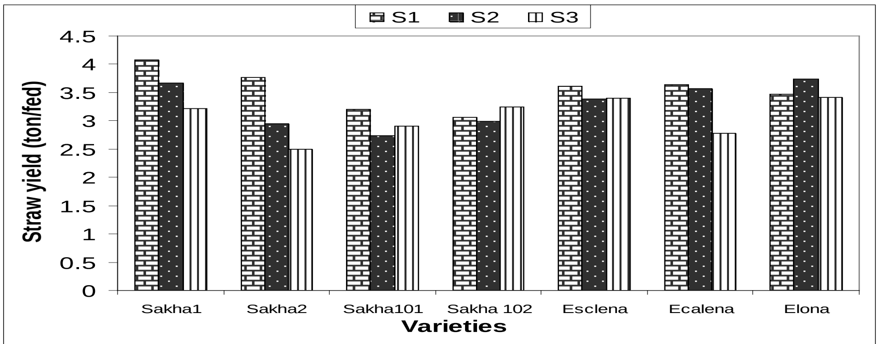

Fig (2): Effect of soil salinity levels (dS/m) on straw yield of flax varieties.

3.2.3:* fiber yield (kg/fed)*:

Data in Table (4) show that fiber yield kg/fed significantly reduced by raising soil salinity level. The maximum values, of fiber Weight (kg/fed) were (781.7, 694.9), (774.4, 775.9) and (769.0, 768.1) for, Elona, Eclena and Esclena at S_1 in both seasons respectively. While at S_2 the corresponding values were (776.2, 715.6) and (798.1, 720.8,) for Elona and Eclena, respectively. While at S_3 these values were (718.7,731.3) for Elona in the first and second seasons, respectively.

3.2.4. Stem radius mm:

Stem radius mm of flax varieties were significantly decreased with increasing soil salinity (Table 4). The highest **stem** radius mm were (2.515,2.525)and (2.213,2.220)at S_1 for Elona and,Eclena while at S_2 the values were (2.005,2.015)and (1.968,1.978) for Elona and Sakha 1. Also, at S_3 the values were (1.618, 1.628) and (1.693, 1.703) for Sakha 1 and Sakha 102 in the two seasons, respectively.

3.2.5 Technical length (*cm)*

Data presented in Table (4) show that, there is a significant decrease in technical length of flax varieties caused by the increase of soil salinity levels. The values of this growth parameter were (104.250, 101.25cm) (93.200,, 87.825) and (87.375, 84.450) at S_1, S_2 and S_3 with Elona in the first and second seasons, respectively.

Generally, salinity is known to have a bad effect on plant growth through its influence on several functions of plant metabolism like osmotic adjustment, ion uptake, protein and nucleic acids synthesis, photosynthesis, enzyme activities and hormonal balance in plant. Also, salinity had adverse effects not only on the biomass yield and relative growth rate, but also on other morphological parameters such as plant height, number of leaves, stem length and shoot / root weight ratio. The results obtained here agree to a great extent, with those obtained by Ebtihal, M. Abd El-Hamid *et al*(2012) ,El-Sanafawy *et al.,* (2011) andYousef *et al*. (2008) who reported that salinity reduced the plant growth, pod, seed number and seed weight.

Table (4): Effect of soil salinity range(s) flax varieties (v) and (s x v) interaction on studied characters during two seasons

Variety	First season			Mean	Second season			Mean
	S1	S2	S3		S1	S2	S3	
	Fiber yield kg/fed							
Sakha1	764.2 a	684.4bc	598.0c	682.2	766.2 a	685.8ab	599.9bc	683.9
Sakha2	704.4 b	455.5d	463.1d	541.0	706.5 ab	646.8 b	465.0c	606.1
Sakha101	637.0 bc	545.0c	580.0c	587.3	644.4 b	547.0 c	582.0bc	591.1
Sakha102	612.0bc	578.0c	650.0b	613.3	611.2 bc	620.0bc	652.0b	627.7
Esclena	769.0 a	724.0b	729.2a	740.7	768.1 a	718.7 a	673.6b	720.1
Ecalena	774.4 a	798.1a	592.7c	721.7	775.9 a	720.8 a	594.8bc	697.2
Elona	781.7 a	776.2ab	718.7a	769.1	696.4 ab	715.6a	731.3a	714.4
Mean	720.4	664.6	618.8	665.1	709.8	664.9	614.1	662.9
	Radius mm							
Sakha1	2.110b	1.968a	1.618a	1.898ab	2.120a	1.978a	1.628a	1.908
Sakha2	1.960 b	1.843a	1.398a	1.733b	1.970b	1.850a	1.408a	1.743
Sakha101	2.100b	1.795a	1.628a	1.841ab	2.110b	1.805a	1.638a	1.851
Sakha102	2.008b	1.865a	1.693a	1.855ab	2.018b	1.875a	1.703a	1.865
Esclena	1.945b	1.780a	1.458a	1.728b	1.955b	1.790a	1.468a	1.738
Ecalena	2.213b	1.753a	1.575a	1.847ab	2.220b	1.763a	1.585a	1.856
Elona	2.515a	2.005a	1.458a	1.993a	2.525a	2.015a	1.468a	2.003
Mean	2.121	1.858	1.546	1.842	2.131	1.868	1.556	1.852
	Technical length cm							
Sakha1	93.275b	84.500c	70.325c	82.700	94.000b	85.625a	71.500c	99.5
Sakha2	90.150b	85.375bc	67.475c	81.000	94.000b	87.275a	69.000c	69.91
Sakha101	91.650b	89.375abc	82.100b	87.708	92.850b	89.400a	86.500ab	68.67
Sakha102	90.525b	86.675bc	83.923ab	89.216	93.250b	90.275a	82.875b	83.41
Esclena	89.500b	87.700bc	86.575ab	87.583	90.550b	86.100a	88.225ab	100.25
Ecalena	92.975b	90.000ab	84.800ab	89.350	92.275b	90.000a	86.325a	86.09
Elona	104.250a	93.200a	87.375a	93.017	101.250a	87.825a	84.450ab	124.58
Mean	93.189	88.118	81.3679	87.225	94.025	87.575	81.793	87.798

3.5: Guideline for tolerant flax varieties to soil salinity :

The yield of the varieties is taken as a criterion when cultivated plants are compared together according to their tolerance to salt. The relative yield of the varieties grown on saline soil is compared with its absolute yield with a normal soil. Data in table (5a) show the threshold (the maximum Ece values not affected the crop yield) and the slope of line describes the relation between ECe increament and the relative decreament of yield %.Data indicated that the sakha 1 and sakha 2 varieties seemed to be more salt tolerant compared with other studied varieties where the threshold was 1.74 and 1.73 respectively, on the other hand Eclena vareitey was the lowest studied varities to salt tolerant. Data also show that saka 2 and sakha1 recoded the lowest decrement in relative yield (8.86and8.71) %wth increasing soil salinity by one unit dS/mover the threshold, (1.73 and 1.73) value respectively, while Esclena and Eclena varities were the less salt tolerant the yield decreased by about were (11.23 and11.08) %.As a result of increasing soil salinity by one unit over the threshold values were (1.69 and1.52) respectively,

Table (5a): Relative yield decrement of flax varieties as influenced by different levels of soil salinity

Varieties	100%	yield decrement				Threshold	Slope%
		90%	75%	50%	0%	a	b
Elona	1.72	2.64	4.03	6.35	10.98.	1.72	10.79
Sakha1	1.74	2.87	4.56	7.38	13.02	1.74	8.86
Sakha2	1.73	2.87	4.59	7.49	13.21	1.73	8.71
Sakha101	1.64	2.57	3.96	6.29	10.94	1.64	10.75
Sakha102	1.73	2.64	4.01	6.28	10.82	1.73	11.0
Esclena	1.69	2.58	3.92	6.14	10.59	1.69	11.23
Eclena	1.52	2.42	3.78	6.03	10.54	1.52	11.08
(FAO)	*1.7*	*2.5*	*3.8*	*5.9*	*10*	*1.7*	*12.05*

Table (5b) : Regression equations for relative yield decrements and values of soil salinity for different flax varieties

Variety	y = a x + b	ECe caused 25% dS/m
Sakha1	y = 8.870x-15.5	4.56
Sakha2	Y= 8.7x-15.01	4.59
Sakha101	y = 10.75x-17.67	3.96
Sakha102	y = 11.0x-19.11	4.01
Esclena	y = 11.24x-19.07	3.92
Eclena	y = 11.09x-16.93	3.78
Elona	y = 10.8x-18.61	4.03

The relative yield decrement % represents the dependent variable and the equation takes the form Y = a x + b Where***:***

y = Relative decrement % x = soil salinity

a = slope (yield reduction % with increasing ECe by one unit.

b = intercept

Table (5b) gives a guide line introduced by FAO (1985) for the effect of soil salinity on relative yield decrement of Flax varieties grown on Kafr El-Sheikh soils. It could be concluded that the values of ECe which cause 25% reduction of yield were 4.56 and 4.36 dS/m for Sakha 1 and Sakha2. The corresponding values were 3.78, 3.92 dS.m for Eclena and Esclena.Also,the threshold were 1.74.,1.73 and 1.72forSakha1,Sakha102 and Elona while the slope (b)8.86 and 9.17 with sakha1 and Sakha2 Comprasion FAO 12.05

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تحمل بعض اصناف الكتان لملوحة التربة

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أجريت تجربتان حقليتان في محطة البحوث الزراعية بسخا – كفر الشيخ خلال موسمي 2010 /2011 و 2011 / 2012 الشتوي بهدف دراسة تأثير مستويات ملوحة التربة المختلفة وهى: S_1 (2-4 ds/m) , S_2 (4-6 ds/m) , S_3 (6-8 ds/m) : على سبعة أصناف من الكتان وهى سخا 1 ، ، سخا 2 ، سخا 101، سخا 102 اسكالينا.اكالينا وايلونا . وكان التصميم الإحصائى المستخدم هو Split Plot Design حيث كانت القطع الرئيسية تمثل مستويات ملوحة التربة والقطع تحت الرئيسية (سبعة أصناف من الكتان).

وقد أظهرت النتائج مايلى :

- زادت الايونات في مستخلص التربة بزيادة ملوحة التربة وكذلك النتروجين الكلي والفوسفور والبوتاسيوم
- تأثرت كل الأصناف تحت الدراسة بمستويات ملوحة التربة المختلفة بتأثيرها على المحصول ومكوناته.
- تأثر محصول البذور (كجم / فدان) بملوحة التربة لكل الأصناف وأخذ الترتيب التالى مع مستويات ملوحة التربة المختلفة تحت المستوي الأول:سخا 1= سخا 2 اكبر من سخا 101=سخا 102= اكالينا=اسكالينا=ايلوناومع المستوي الثاني:سخا 1= سخا 2 اكبر من اسكالينا=اكالينا=ايلونا-=سخا 101=سخا 102ومع المستوي الثالث: =سخا 1=سخا 2 اكبر من اكالينا=ايلونا=سخا101=سخا102اكبر من اسكالينا
- زيادة ملوحة التربة ادت الي نقص محصول القش (طن/فدان)كالاتي:

مع المستوي الأول:سخا1= سخا2=اسكالينا=اكالينا=ايلونااكبر من سخا101=سخا102-
ومع المستوي الثاني:سخا1=اسكالينا=اكالينا-ايلونا اكبر من سخا101=سخا102 = سخا2
ومع المستوي الثالث:اسكالينا=اكالينا=ايلونا=سخا101=سخا102=سخا1اكبر من سخا2

- زيادة ملوحة التربة أدت إلى نقص محصول الالياف كجم /فدان قطر الساق والطول الفعال.
- أظهرت أصناف سخا 1 وسخا2 تحمل أكثر لملوحة التربة طبقاً لـ FAO (1985) بمحصول البذور
- اظهرت اصناف سخا 101 و102متوسطة التحمل للملوحة بمحصول البذور
- اظهرت اصناف اسكالينا و اكالينا اكثر حساسية للملوحة بمحصول البذور

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