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IMPACT OF IRRIGATION WATER SALINITY LEVELS ON SOME SOIL CHEMICAL PROPERTIES AND SOME FLAX VARIETIES

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ABSTRACT

Pot experiments were conducted in a wire proof greenhouse at Sakha Agricultural Research Station during seasons 2010/2011 to estimate the influence of water salinity on some soil chemical properties, yield and yield components of four flax varieties. Three water salinity levels 0.5 dS/m (W1)1.94 dS/m (W2) and 3.75 dS/m (W3), four flax varieties of Sakha1, Sakha2, Escelna and Elona and three levels of phosphorus fertilizers; without fertilizers (P_0) 0, 15.5%p_2O_5 (p_1) and 22.5%p_2O_5 (p_2) were applied in pots which filled with 9 kg of non saline clay soil

The obtained results could be summarized as follows:

Dramatic increase of soil salinity was shown after harvesting due to increasing irrigation water salinity i.e., from 2.7dS/m before planting to 2.82, 5.68, and 10.67, dS/m with W1, W2, and W3, respectively. As well as SAR values were increased from 4.39, before planting to4.71,6.90 and (13.35) with W1, W2 and W3 respectively. Also, HCO^-_3, CL and Na^+ were increased with increasing irrigation water salinity.

Irrigation water salinity significantly affected flax yield and yield components. Flax seed yield g /pot had generally, the following sequence with different irrigation waters and phosphorus fertilizer levels

Sakha 2 >Sakha1 >Esclena > Elona .Phosphorus treatments ,geneally increased flax seeds and straw yields of the studied varieties.

Straw yield (g/pot), technical length, and 1000-seed weight were significantly decreased with increasing irrigation water salinity levels.

Sakha 2 and Sakha1 were the highest tolerant varieties of flax to irrigation water salinity. While the varieties Esclena and Elona were the moderate ones according to FAO (1985), under the experimental conditions.

Keywords: Flax, water salinity, phosphorus fertilizer.

INTRODUCTION

Soil and /or water salinity is one of the major biotic stresses that reduce plant growth and crop productivity worldwide. More than 800 million hectares of land throughout the world are salt-affected (including both saline and sodic soils), equating to more than 6% of the world's total land area (FAO 2008). Some of the most serious examples of salinity occur in the arid and semiarid regions, for example, in Iran, Pakistan, Egypt, and Argentina, out of the total land area of 162.2, 77.1, 99.5, and 237.7 million hectares, about23.8, 10, 8.7, and 33.1 million hectares are salt-affected, respectively (FAO 2008).Under Egyptian conditions, the shortage of fresh water resources for agricultural expansion are noticed. Thus, an urgent need for using low quality water for this purpose is a vital importance. However the use of saline waters for irrigation affects many soil properties such as these related to ion exchange equilibrium and salt concentration, (El Kouny 2002, and Jalali *et al.* 2008).

Soil properties are considered as important factors controlling most of soil conditions and soil plant relationships Wassif *et al.* (1997) studied that, most important factors affecting broad bean production are soil salinity and or irrigation water salinity.

Salt has three folds effects: it reduces water potential, causes ion imbalance or disturbance and ion toxicity. This altered water status leads to initial growth reduction and limitation of plant productivity. Since salt stress involves both osmotic and ionic stress (Benlloch-Gonzales *et al.* 2005). Salt stress affects all the major processes such as growth photosynthesis, protein synthesis and energy and lipid metabolism (Parida and Das 2005 and Albino Maggio *et al.* 2007).

Katerji-Ni *et al.*, (1992) studied the effect of 3 salinity levels of water on bean by adding NaCl, $CaCl_2$ and $MgSO_4$ to fresh water (0.9 dS/m = control), to gave 2.1 dS/m and 4.0 dS/m). Their data showed clear decrease in leaf area, dry matter production and yield with the increases of water salinity. Sharma (1991) showed that, in pot experiment irrigated with water salinity levels of 1.5, 4.5, 7.8 and 13.7 dS/m, shoot growth was more decreased than root growth. Pascale *et al.*, (1997) found that the 5 dS/m soil salinity led to 50% of yield reduction compared to 4.7 dS/m in the Van Genuchthen model. The shortage of suitable water requires selection of genotypes with a species can there be expected to provide useful material for experimental comparisons with ordinary relatively salt sensitivity (Shannon *et al.*, 1987). In general, beans are reported to be sensitive to salt but some species may be moderately tolerant. (Mass and Hoffman 1977).Flax (Linum usitatissimum L.) is an ancient crop grown in several regions world for both fiber and seed production. In Egypt, it ranks second after cotton in fiber production but ranks fourth in oil seed production .Flax fiber is soft, lustrous and flexible, but not as that of cotton or wool. It is however, stronger than cotton, rayon or wool, but weaker than ramie. Owing to its length, flax fiber is suitable for strong yarns such as that used for sewing threads; flax is the most important dual purpose crop for oil and fiber production in

Egypt and in the world, as well. Flax plays an important role in the national economy due to its importance in exportation and many local industrial purposes, EL-Gazzar (1997), Sharief *et al* (2005**).**

MATERIALS AND METHODS

Pot experiments were conducted in a wire proof greenhouse at Sakha Agricultural Research Station during winter seasons 2010/2011. This study amid to investigate the effect of three salinity levels of irrigation water on some soil chemical properties and four flax varieties, (Sakha 1, Sakha 2 , Escelna and Elona) yield and yield component.

Plastic pots 30 cm in width and 30 cm in deep were filled with 9 kg of disturbed non saline clay soil collected from the surface layer (0-30 cm) of Sakha Agricultural Research Station Farm. Some chemical and physical properties of experimental soil are shown in Table 1. Flax varieties were planted in 25^{th} Nov. 2010. After two weeks of sowing the seedlings were thinned to 10 plants /pot.

The first irrigation for each pot was done with fresh water. After germination, constant volume of artificially salinized water equivalent to field capacity was used for irrigation. Three levels of water salinity 0.5(W1), 1.94

(W2) and 3.75 (W3) dS/m were used for irrigation. The artificially water salinity were prepared using a base of tap water with Na and Ca at SAR = 6 by using a mixture of $CaCl_2$ and NaCl Salts. The traditional agricultural practices for *flax* varieties were separately made and nitrogen and phosphorus were applied at the rate of 60 kg N/fed and 0, 15.5and22.5 kg P_2O_5/fed (p_0, p_1 and p_2). Nitrogen was applied as urea (46.5% N) in two dose after thinning and one month from first irrigation, phosphorus was applied as superphosphate (15.5% P_2O_5) at three rate p_0, p_1 and p_2 (0, 15.5 and 22.5) p_2o_5 kg/fed in one dose before sowing and potassium fertilizer was added in the form of potassium sulphate (48% K_2O) at rate 24 K_2O kg /fed after one month of planting.

The statistical analysis was done under the split-split plots design with three replicates. The main plots were assigned by salinity of irrigation, sub plots were randomly assigned by phosphorus fertilizer levels and the sub-sub plots were allocated by flax varieties.

Plants were harvested at maturity stage at 15 th May2011 and yields of flax were weighted g/pot. Soil samples after harvesting were analyzed for ECe, total N %, available P, K and soluble ions, according to standard methods of (Page *et al.*, 1982).

Statistical analysis was carried out according to (Gomes and Gomes 1984).

Table (1): Some chemical and physical properties of soil used

	*	**	Soluble cation meq/L				Soluble anion meq/L				
	pH 1:2.5	ECe dS/m	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}	SAR
Properties	8.04	2.7	11.1	3.6	12	0.3	-	2.6	10.4	14	4.39
	Total N%	Available ppm		F.C. %	O.M %	Particle size distribution			Texture		
		P	K			Clay	Silt	sand			
	0.11	6.7	300	39	1.3	55	24	21	Clayey		

*** 1:2.5 Soil: Water suspension** **** Soil paste extract**

RESULTS AND DISCUSSION

Effect of saline irrigation water on some soil chemical properties:

Data presented in Table (2) show that ECe and SAR of soil paste extracts greatly increased with increasing salinity levels as compared with control treatment. ECe values indicate that the increase in the soil salinity was promoted by more than 2.01 fold with W2 3.78 fold with W3, in comparison with soil irrigated with control (W1) (EC 0.5 dS/m). This may be ascribed to the addition of the more soluble bases into the soil through the application of saline water. The same trend was found by Abd El-Nour (1989) and El-Etrieby *et al.*, (2001). They noted that EC and SAR values of soil were increased as a result of rising salinity of irrigation water. The recorded data in Table (2) show that SAR values were increased from (4.39 - 4.71) with W1 to (4.39 – 6.90) and (4.39-13.35)) with W2, and W3, respectively. Also data in Table (2) show that chloride (Cl^-) content (meq/L) in the soil irrigated with saline water increased from (10.4 – 11.2) with W1 (10.4 -22.6), (10.4-52.2), meq/L with W2, W3, respectively.

On the other hand data in Table (2) show that soluble Na^+ increased from (12-12.9 meq/L) with W1 and (12.9 - 26.2), (12.9 -61.1) meq/l with W2, W3, respectively. This is in fact due to irrigation water salinity. These results are in agreement with those obtained by El-Etrieby *et al.* (2001) and Atwa (2005). They found that soil content of soluble Na+ was increased with increasing the salinity of irrigation water.

Table (2): Some chemical analysis of soil after harvesting of flax

Season	Irrigation water salinity dS/m	ECe dS/m	Soluble cation meq/L				Soluble anion meq/L				Total N %	Available ppm		SAR
			Ca^{+2}	Mg^{+2}	Na^+	K^+	CO_3^{--}	HCO_3^-	Cl^-	So_4^{--}		P	K	
2010/11	W1 (0.50)	2.82	11.2	3.8	12.9	0.29	-	2.7	11.2	14.3	0.09	6.0	260	4.71
	W2 1.94)	5.68	20.79	8.06	26.2	1.63	-	7.4	22.6	26.8	010	6.1	270	6.90
	W3 (3.75)	10.67	33.63	8.3	61.1	1.64	-	7.87	52.2	44.6	0.10	6.1	270	13.35

Crop yields:

Data in Table (3) show that, increasing salt concentration of the irrigation water reduced all the crop characteristics studied.

Seed yield (g/pot):

The statistical analysis indicates that, irrigation water salinity levels have significant harmful effect on seed yield of flax varieties in. Table (3) and (Fig.1) from the presented data (Table 3) it is clear that sakha2 was the suitable variety for the irrigation water salinity and phosphorus treatments from $p_0$to p_1 and p_2 increased mean seed yield from 5.9 to 7.28 and 7.61 g/pot, respectively, under w1 irrigation treatment .Under w2 the increases in the mean seed yield were from 4.9 to6.0and 6.0g/pot, respectively. On the other hand increasing irrigation water salinity from w1 to w2 led to decreasing the mean seed yield value by 19%. The seed yield, g/pot was arranged as follow:

With W1 at P_0: Sakha 1 =Sakha2 > Esclena > Elona
With W1 at P_1: Sakha 1 >Sakha2 > Esclena > Elona
With W1 at P_2: Sakha 2 =sakha1 > Esclena > elona
With W2 at P_0: Sakha 2 =sakha1 >Esclena > Elona
With W2 at P_1: Sakha 2 =sakha1 >E sclena > Elona
With W2 at P_2: Sakha 2 >sakha1 >E sclena > Elona
With W3 at P_0: Sakha 2 >sakha1 > Esclena > Eona
With W3 at P_1: Sakha 2 >sakha1 >E sclena > Elona
With W3 at P_2: Sakha 2 >sakha1> Esclena > Elona

Straw yield (g/pot) :

Straw yield, g/pot, significantly decreased with increasing water salinity levels but the reduction in straw yield less than that of the seed yield. From the presented data (Table 3) and (Fig. 2), it is clear that sakha1 was the suitable variety for the irrigation water salinity . Phosphorus treatments from p0to p1 and p2 increased mean straw yield from 20.384 to 23.815 and 28.416 g/pot, respectively, under w1 irrigation treatments. Under w_2 the increases in the mean straw yield were from 20.554 to20.609and 25.058 g/pot, respectively. On the other hand increasing irrigation water salinity from w1 to w2 led to decreasing the mean straw yield value by 8%. The straw yield, g/pot was arranged as follow:

With W1 at P_0: Sakha 1 =sakha2= Esclena > Elona
With W1 at P_1: Sakha 1 =sakha2 =Esclena > Elona
With W1at P_2: Sakha 2 >sakha2 = Esclena = Elona
With W2 at P_0: Sakha 1 =sakha2 =Esclena = Elona
With W2 at P_1: Sakha 1 =sakha2 =E sclena = Elona
With W2 at P_2: Sakha 1 >sakha2 =E sclena = Elona
With W3 at P_0: Sakha 1 =sakha2 = Esclena> Elona
With W3 at P_1: Sakha 2 >sakha1 =E sclena = Elona
With W3 at P2: Sakha 2 =sakha1=Esclena > Elona

Table (3): Effect of irrigation water salinity on seed weight and straw yield of some flax varieties

Variety	(Water salinity dS/m)			
	P0	P1	P2	mean
Seed yield g/pot W1 (0.5 dS/m)				
Sakha1	7.797**a**	9.813**a**	9.923**a**	9.177
Sakha2	6.740**a**	9.500**b**	10.53a	8.923
Escelna	5.290**b**	5.480**c**	5.600**b**	5.456
Elona	3.920**c**	4.357**d**	4.413**c**	4.230
Mean	5.936	7.287	7.616	6.996
Seed yield g/pot W2 (1.94 dS/m)				
Sakha1	6.267**a**	8.300**a**	7.567**b**	7.378
Sakha2	6.200**a**	8.200**a**	8.500**a**	7.633
Escelna	4.167**b**	4.473**b**	4.500**c**	4.380
Elona	3.167**c**	3.157**d**	3.550**d**	3.291
Mean	4.950	6.032	6.029	5.670
Seed yield g/pot W3 (3.75 dS/m)				
Sakha1	4.753**b**	6.083**b**	6.467b	5.767
Sakha2	5.267**a**	6.600**a**	7.020**a**	6.295
Esclena	3.380**c**	3.517**c**	3.603**c**	3.500
Elona	2.533**d**	2.850**d**	2.900**d**	2.761
Mean	3.983	4.762	4.997	4.580
Straw yield g/pot at W1 (0.5 dS/m)				
Sakha1	21.850**a**	26.357**a**	31.290**a**	26.499
Sakha2	19.340**a**	23.700**ab**	27.283**b**	23.441
Escelna	21.553**a**	23.917**ab**	27.077**b**	24.182
Elona	18.813**b**	21.287**b**	28.017**b**	22.702
Mean	20.384	23.815	28.416	24.206
Straw yield g/pot at W2 (1.94 dS/m)				
Sakha1	21.850a	21.143a	29.100a	24.031
Sakha2	19.340a	21.173a	24.867b	21.793
Escelna	22.213a	21.307a	23.400b	22.307
Elona	18.813a	18.813a	22.867b	20.164
Mean	20.554	20.609	25.058	22.073
Straw yield g/pot at W3 (3.75 dS/m)				
Sakha1	19.100a	23.137b	25.167a	22.468
Sakha2	19.350a	23.767a	24.273ab	22.463
Esclena	18.500a	19.977b	24.967ab	21.148
Elona	16.567b	17.933b	21.393b	18.631
Mean	18.379	21.203	23.950	21.177

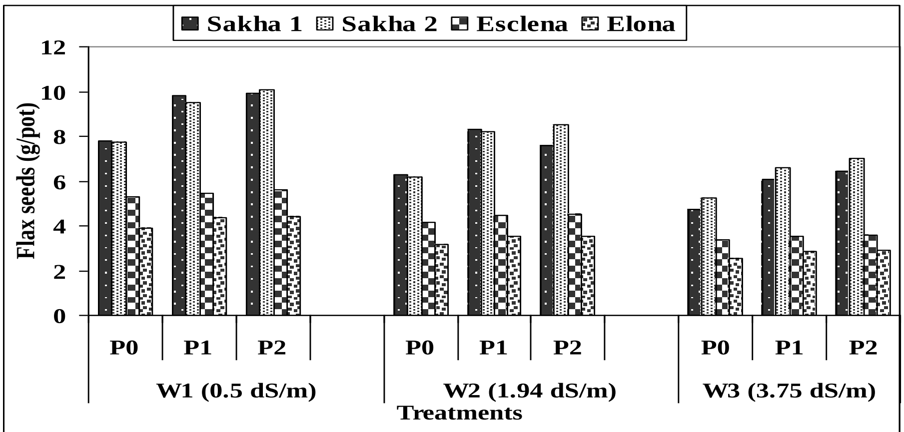

Fig (1): Effect of irrigation salinity and phosphorus fertilizares levels on seed yield (g/pot)

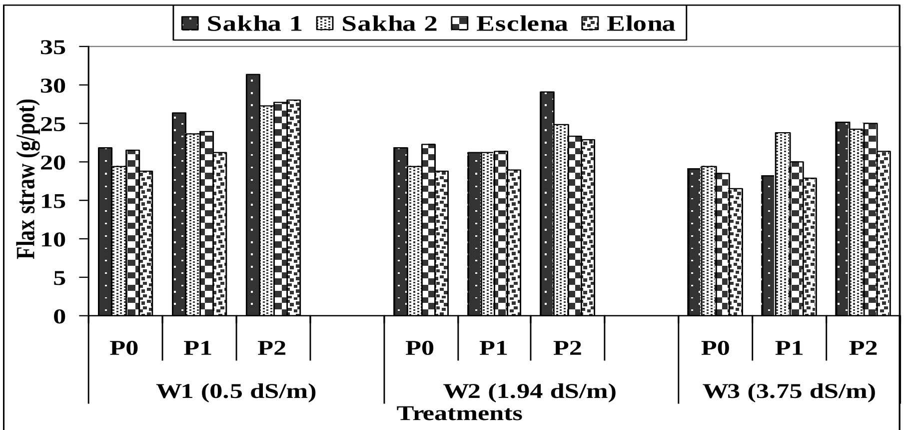

Fig (2): Effect of irrigation salinity and phosphorus fertilizares levels on straw yield (g/pot)

Technical length (cm):

Technical length (cm) significantly decreased with increasing water salinity levels. W1. W2. and W3. Table (4) .The technical length (cm) can be arranged as follow:

With W1 at P_0: Sakha 1 =Esclena >sakha2=Elona
With W1 at P_1: Sakha 1 >Sakha1 >Esclena >Elona
With W1 at P_2: Elona >Sakha1= Sakha2 =Esclena
With W2 at P_0: Sakha 1 =Sakha2 =Esclena = Elona
With W2 at $_{P1}$: Sakha 1 =Sakha2 =Esclena =Elona
With W2 at P_2: Sakha 1 =Sakha2 =Esclena =Elona
With W3 at P_0: Sakha 1 =Sakha2 = Esclena = Elona
With W3 at P_1: Elona >Esclena = Sakha2=Sakha1
With W3 at P_2: Esclena =Elona>sakha1 > sakha2

1000 -seeds weight (g):

1000-seed weight (g) of flax varieties was significantly decreased with increasing water salinity levels (Table 4). The highest 1000-seed weight (6.450, 7.233, and 7.400) g/pot under (p_0, p_1 and p_2) was obtained with sakha1 at W1, respectively. While at W2 the weight (6.133), (6.167), (6.167)g/pot under (p_0, p_1 and p_2) with sakha1, respectively. Also were (4.733.4.867.4.967,) g/pot under (p_0, p_1 and p_2) with sakha1 at w3, respectively.

In general the order of the effect of water salinity were W1< W2< W3 on the reduction of yield and yield component of flax varieties due to the deleterious effect of salinity on leaf area and net assimilation rate leading to a reduction in the amount of dry matter translocated and stored in the seeds (Abou-Khadrah *et al.*, 1999).

Super phosphate fertilizer and its chemical composition of Ca $(H_2pO_4)_2$ $CaSO_4$ as well as the presence of gypsum helps in reducing the risk of sodium. It can correct soil salinity problems by applying a product containing calcium. The least expensive and most often used product is “gypsum”. Gypsum works fairly quickly as it reacts with the sodium. The Calcium (Ca) in gypsum prevents Na to be adsorbed on clay so preventing soil deterioration gypsum reacts with the sodium forming sodium sulfate. Sodium sulfate is a highly water-soluble material that is easily leached below the root zone. This process also repairs soil structure so soil particles can bind with each other again.

Guideline for responding flax varieties to irrigation water salinity:

The yield of crop is taken as a criterion when cultivated plants are compared together according to their tolerance to salt stress. The relative yield of the crops irrigated with saline water is compared with its absolute yield irrigated with fresh water. The salinity level of irrigation water causing a 25% yield reduction is taken as a threshold for the given variety (FAO, 1985).

Data of the relative decrement of yield versus salinity of water were evaluated throughout linear equations for flax varieties. The relative yield decrement % represents the dependent variable and the equation takes the form

$$y = a x + b$$

Where:

y = relative decrement %

x = water salinity

a = (slope) yield reduction % with increasing ECw by one unit

b = the intercept

The regression equations describe the effect of water salinity (ECw) on yield decrement % of ten varieties of flax were calculated and shown in Table (5).

Table (4): Effect of irrigation water salinity on Technical length (cm) and 1000-seed (g) of studied flax varieties

Variety	(Water salinity dS/m)			
	P0	P1	P2	mean
Technical Length cm W1 (0.5 dS/m)				
Sakha1	66.00**a**	73.700**a**	82.867**b**	74.189
Sakha2	57.133**b**	66.267**b**	80.200**b**	67.867
Escelna	62.00**ab**	65.933**b**	80.267**b**	69.400
Elona	56.167**b**	65.533**b**	90.333**a**	70.678
Mean	60.325	67.858	83.416	70.533
Technical Length cm W2 (1.94 dS/m)				
Sakha1	60.833a	70.700a	74.933a	68.822
Sakha2	60.467a	73.033a	75.167a	69.556
Escelna	59.333a	75.133a	76.900a	70.456
Elona	63.00a	77.867a	79..200a	73.356
Mean	60.908	74.183	76.55	70.547
Technical Length cmW3 (3.75 dS/m)				
Sakha1	58.967**a**	59.733**b**	60.933**b**	59.878
Sakha2	55.800**a**	62.00**b**	57.467c	58.422
Esclena	55.00**a**	62.333**b**	76.367a	64.567
Elona	61.00**a**	73.333**a**	74.333a	69.556
Mean	57.691	64.349	67.275	63.105
1000-seed weight g W1 (.5 dS/m)				
Sakha1	6.450a	7.233a	7.400a	7.051
Sakha2	6.033b	6.200b	6.300b	6.177
Esclena	5.700c	5.767c	5.767d	5.744
Elona	6.033b	6.133b	6.133c	6.099
Mean	6.054	6.333	6.400	6.269
1000-seed weight g W2 (1.94 dS/m)				
Sakha1	6.133a	6.167a	6.167a	6.155
Sakha2	5.767b	5.800b	5.800b	5.789
Esclena	5.300c	5.400c	5.367c	5.355
Elona	5.867b	5.800b	5.900b	5.855
Mean	5.766	5.791	5.808	5.788
1000-seed weight g W3 (3.752 dS/m)				
Sakha1	4.733a	4.867a	4.967a	4.855
Sakha2	4.500b	4.500b	4.600b	4.533
Esclena	4.167c	4.200c	4.267c	4.211
Elona	4.700a	4.400b	4.600b	4.566
Mean	4.525	4.491	4.608	4.541

From data in Table (5) it could be showed that Sakha 2 and Sakha1 can be classified as tolerant varieties where the threshold values were 3.01, and 2.60 dS/m, respectively. According to the FAO (1985) that the threshold more than2.5 dS/m indicate that the variety is tolerant. While Esclena and Elona can be classified as moderate varieties where the threshold values were 2.49 dS/m and 2.54 dS/m comparison with the value recorded by FAO (2.5. dS/m caused reduction 25% in yield).

Table 5: **Regression equations for yield decrement and values of tolerant water salinity for different flax varieties**

Variety	y = a x + b	EC_w dS/m caused 25% reduction
-	**Without (p_0)**	0.00
Sakha1	y = 11.72x-2.980	2.39
Sakha2	y = 9.485x-1.087	2.75
Esclena	y = 10.67x-1.256	2.46
Elona	y = 10.47x-1.151	2.49
	Rate =15.5 p_2O_5 (p_1)	
Sakha 1	y = 11.61x-5.158	2.59
Sakha 2	y = 9.241x-2.892	3.01
Esclena	y = 10.59x-1.383	2.49
Elona	y = 10.21x-.784	2.52
	Rate =22.5 p_2O_5 (p_2)	
Sakha1	y = 11.62x-5.197	2.60
Sakha2	y=9.035x-2.033	2.99
Esclena	y=10.57x-1.321	2.49
Elona	y=10.12x-.758	2.54
	FAO (1985)	2.5

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تأثير ملوحة ماء الرى على بعض خواص الأرض الكيميائية وبعض أصناف الكتان

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الهدف الرئيسى لهذا البحث هو دراسة وتقييم إنتاجية اربعة أصناف من الكتان وكذلك بعض خواص الأرض الكيميائية تحت مستويات مختلفة من ملوحة ماء الرى حيث أقيمت تجربتى أصص داخل الصوبه السلكيه بمحطة البحوث الزراعية بسخا – محافظة كفر الشيخ خلال موسمى ٢٠١٠/٢٠١١ وكانت الأصناف هى : سخا١ ، سخا٢ ، اسكالينا ايلونا، تحت ثلاثة مستويات مختلفة من ملوحة ماء الرى وهى

W1= 0.5 dS/m, W2=1.94dS/m W 3=3.75dS/m

وتتلخص النتائج التى تم التحصل عليها فيما يلى :

أدت زيادة ملوحة ماء الرى إلى زيادة ملوحة التربة بعد حصاد المحصول من (2.7) dS/m قبل الزراعة إلى (، 2.82) (5.68) (10.67) dS/m عند معاملات ملوحة الرىW1 ، W2 ،W3 على الترتيب كذلك زادت نسبة إدمصاص الصوديوم (SAR) وكانت (4.38) قبل الزراعة إلى (4.71) ,(13.35) ,(6.90)مع,W1 ,W2 W3 , بعد حصاد المحصول على الترتيب

كما أدت زيادة ملوحة ماء الرى إلى زيادة أيونات Cl^- , Na^+ فى المحلول الأرضى بعد الزراعة.

بزيادة ملوحة ماء الرى إنخفض المحصول ومكوناته لأصناف الكتان ويختلف النقص وذلك تبعا لإختلاف الصنف وملوحة ماء الرى.

أظهرت الأصناف الترتيب التنازلى الآتى وفقاً لإنتاجية البذور و إنتاجية الأصناف مع مستويات ملوحة ماء الرى المختلفة سخا ٢ > سخا١ > اسكالينا > ايلونا .كما أوضحت النتائج أن زيادة ملوحة ماء الرى أدى إلى نقص محصول القش ,والطول الفعال والطول الثمري ووزن الالف بذرة تبعاً لإختلاف الأصناف وتوضح النتائج أن الأصناف ، سخا٢ وسخا١ أكثر الأصناف تحملا لملوحة ماء الرى .

ادت المعاملات الفوسفاتية الي زيادة محصول الكتان من البذور والقش للاصناف المدروسة. مما يمكن التوصية بزراعتها فى حالات الإضطرار لإستخدام مثل هذه النوعيات من مياه الرى للـ FAO (1985).

قام بتحكيم البحث

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