TOLERANCE OF SOME FABA BEAN VARIETIES TO SOIL SALINITY LEVELS

By

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ABSTRACT

Two field experiments were conducted at the experimental farm of Sakha Agricultural Research Station during 2006/2007 and 2007/2008 seasons. The objectives of this investigation were to study the tolerance of some faba bean varieties to different soil salinity levels.

Seven faba bean varieties i.e Nobaria 1, Sakha 1, Sakha 2, Sakha 3, Giza 3, Giza 461 and Rina More were grown under three levels of soil salinity 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 faba bean varieties were allocaited in sub plot whereas the main plots were assigned by the salinity levels with four replicates.

The obtained results can be summarized as follow:

Soil salinity significantly affected faba bean yield and yield components. Faba bean seed yield (ardab /fed.) had the following sequence at the salinity level S_1: Sakha 2 > Sakha 3 = Giza 461 > Sakha 1 = Rina More > Noburia 1 > Giza 3, the corresponding sequence at S_2 level was : Sakha 2 > Sakha 3 > Noburia 1 = Sakha 1 > Giza 3 = Giza 461 = Rina More while at S_3 : it was Sakha 2 > Noburia 1 = Sakha 1 > Sakha 3 > Giza 3 > Giza 461 = Rina More.

Straw yield (ton/fed.), number of pods / plant, number of seed /plant and 100-seed weight significantly decreased with increasing soil salinity levels.

Faba bean varieties Sakha 2 and Noburia 1 were the highest tolerant varieties to soil salinity. whereas the varieties Giza 461 and Rina More was the most sensitive one to soil salinity. The varieties Sakha 3, Giza 3 , Sakha 1 were of moderate tolerance to soil salinity.

Soil salinity significantly affected protein, phosphorus and potassium (%). Faba bean seed variety Sakha 2 gave the highest protein, phosphorus and potassium concentrations.

1- INTRODUCTION

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 northen part of the country especially in Kafr El-Seikh 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 managements of salt affected soil require a good understanding of crop- salinity relations, particularly under field condition.

It is common that field crop differ greatly in their tolerance to salinity and the differences in salt tolerance often occur between different varieties of a given species. Actual, response to salinity varieties also according to stage of plant growth (Jefferies, 1988).

Salinity seriously constrains crop yield in irrigated agriculture throughout the world. Nearly one third of the world's irrigated agricultural land is saline, and (Shannon, 1984) estimates salt-affected soil by about 400-950 x 10^6 ha.

Saline and alkaline soils are the major problems which affects productivity of common bean in arid and semi-arid regains such as Egypt. It has bean generally recorded that salinity adversely affects seed germination and seedling growth as well as relevant metabolic processes of some glycophytic plants (Ahmed *et al.*, 1983; Drossopoulos *et al.*, 1987).

Faba been (Vicia faba L.) is the most important legume crop in Egypt, due to its high nutritive value for human food and its role break crop in cereal rotation system. The planted area was about 216.000 feddans in the last five seasons with an average seed yield of 9.0 ardab/feddan. In northern part of Egypt the planted area represents about 85% of the total planted faba bean area. El-Galaly, Ola *et al.* 2008). About 20 to 30 % of the bean production areas in the Middle East are affected by soil salinity (Boyelo- Jimenes *et al.*, 2002). Under such a striation, yield is expected to be low as the common bean is extremely sensitive to salinity and suffers yield losses at soil salinity levels more than 2 dSm^{-1} (Lauchli, 1984). However, common bean and other legumes are regarded as appropriate crops for the enhancement of bioproductivity and the reclamation of marginal lands. Salinity reduces the ability of plants to utilize water and causes a reduction in growth rate, as well as changes in plant metabolic

processes (Munns, 1993 and 2002). Plants growing under saline conditions are stressed basically in three ways; (1) reduced water potential in the root zone causing water deficit, (2) phytotoxicity of ions such as Na^+ and Cl^- and (3) nutrient imbalance by depression in uptake and/or shoot transport (Lauchli, 1986; Marschner, 1995). Atwa *et al.*, (2008) conducted pots studies on the role of irrigation water salinity on the studied varieties of faba bean to achieve the principal knowledge about sensitivity and tolerance of these varieties to salinity. He found that faba bean: Misr 2, Misr 1 and Sakha 2 were the highest tolerant varieties to irrigation water salinity, while the varieties Giza 461, Rina More were the lowest one. The objective of the present study is to apply results of pot experiment on the field scale aiming at selecting strains more tolerant to salinity stress. Therefore this research was conducted to study the effect of three ranges of soil salinity under field condition on some of faba bean varieties.

2- MATERIAL AND METHODS

Two field experiments were conducted at the experimental farm of Sakha Agricultural Research Station during two successive seasons of 2006 /2007 and 2007/2008 to study the effect of three levels of soil salinity (S_1 2 : <4) (S_2 4 : <6) (S_3 6 :<8) dS/m under field conditions on yield and yield component characteristics of seven faba bean varieties i.e Nobaria 1, Giza 3, Giza 461, Sakha 1 , Sakha 2, Sakha 3 and Rina More (Spain) variety. The experiments were conducted in split plot design with four replicates. The main plots were assigned by soil salinity levels and sub plots were randomly assigned by faba bean verities, with four replicates.

The land was prepared for planting and divided into 84 plots, each plot consisted of 7 ridges. The ridge was (3m) in length and (0.6 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 (from 3 ridges) at depths of 0-30 and 30-60 cm were taken. These samples were air dried, ground, sieved before planting to obtain the particle size distribution, soluble cations and anions, pH, EC, total-N % available P and K. A map was done for salinity distribution (average 0-60 cm) for every season as fellow. 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 10th of November in both seasons. The experiments plots were treated with 22.5 kg P_2O_5/fed. as super phosphate fertilizer (15.5 P_2O_5) in one dose before sowing. Nitrogen

Table (1) : Some chemical and physical properties of the tested soil (0 - 60 cm depth) before planting in both season of 2006/2007 and 2007/2008.

Season	pH 1:2.5 Soil water suspension	Soil salinity range ECe/dSm^{-1}	Means of soluble ions – meq / L								SAR
			Soluble cation meq/L				Soluble anion meq/L				
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3^{-}	Cl^{-}	SO_4^{2-}	
2006/2007	7.80	2: <4 (S1)	8.8	3.1	14.5	3.6	-	3.00	14.0	13	5.95
	7.90	4: <6 (S2)	15.1	6.8	23.4	4.7	-	3.5	22.0	24.5	7.07
	8.10	6: <8 (S3)	20.63	9.8	33.7	5.87	-	5.4	30.0	34.6	8.64
2007/2008	7.82	2: <4 (S1)	8.9	3.4	13.7	4.0	-	3.0	13.5	13.5	5.52
	7.95	4: <6 (S2)	16.0	7.0	22.5	4.5	-	3.4	21.0	25.6	6.64
	8.11	6: <8 (S3)	22.0	10.0	32.1	5.9		5.2	31.0	33.8	8.03

Total N %	Available		O.M %	Particle size distribution %			
	P mg kg^{-1}	K mg kg^{-1}		Clay	Silt	sand	Text -true
0.10	6.8	300	1.3	53.5	22.9	23.6	Clayey
0.10	6.7	320	1.3	53.6	22.8	23.6	Clayey
0.09	7.0	350	1.25	53.7	22.6	23.7	Clayey
0.12	6.5	320	1.31	53.6	22.5	23.9	Clayey
0.18	6.6	330	1.32	53.7	22.6	23.7	Clayey
0.14	7.1	350	1.34	53.8	22.7	23.5	Clayey

was applied at rate 15 kg N/fed. (urea 46.5% N) in one dose after thinning whereas potassium fertilizer was added in form of potassium sulphate (48% K_2O) at rate 24 K2O kg/fed after one month of planting.

The other agricultural practices were carried out as recommended 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). Some chemical and physical properties of the two experimental sites are shown in Table (1). Representative samples of faba bean varieties were taken at harvesting to determine the following characteristics: Seed yield (ardab/fed.), straw yield (ton/fed.), weight of 100 seed (g), number of seed /plant and number of pods /plant recorded.

Data were subjected to statistical analysis according Gomez and Gomez (1984) for split – plot design for all studies characters by using Irristat (Computer Program) (Duncan's 1955).

3- RESULTS AND DISCUSSIONS

3.1 : Soil chemical properties after harvesting :

Data presented in Table (2) show that SAR of soil paste extracts after harvesting greatly increased with increasing salinity compared to before harvesting. This may be due to the restricted drainage of the soil under study. Total nitrogen % and available phosphours, potassium (mg kg^{-1}) increased with increasing soil salinity. 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, as well as the inefficient bacterial nodulation.

3.2 : Crop yields :

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

3.2.1 : Seed yield (ardab /fed.)

Giza 461, Rina More and Giza 3 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 mean values of seed yield (ardab/fed.) were (12.13, 12.22), (10.90, 10.84) and (10.85, 10.89) (ardab/fed.) at S_1 with Sakha 2, Sakha 3 and Giza 461 in the first and second seasons, respectively.

Also the maximum mean values of seed yield (Ardab/fed.) were (10.05 , 10.08), (8.25 , 8.06) and (7.8, 7.74) at S_2 with Sakha 2, Sakha

3 and Nobaria 1. While the maximum mean values of seed yield (ardab /fed.) were (9.13 , 9.09) (7.31, 7.2) and (7.03, 6.97) with Sakha 2, Nubaria 1 and Sakha 1 at S_3 in both seasons, respectively.

The sequences indicate that the most sensitive to salinity were Giza 461 and Rina More. Similar results were obtained by Mansour and Bastawisy (1997), Gaballah and Gomaa (2004) and Atwa *et al.* (2008).

The used verities were arranged according to seed yield (ardab/fed.) as follow :

With S_1 : Sakha 2 > Sakha 3 = Giza 461 > Sakha 1 = Rina More > Noburia 1 > Giza 3.

With S_2 : Sakha 2 > Sakha 3 > Noburia 1 = Sakha 1 > Giza 3 = Giza 461 = Rina More.

With S_3 : Sakha 2 > Noburia 1 = Sakha 1 > Sakha 3 > Giza 3 > Giza 461 = Rina More.

3.2.2 : Straw yield (ton/fed.):

Data in Table (3) and Fig. (2) showed that the decrease occurred in straw yield due to effect of salinity stress was less than the corresponding are occurred in seed yield. The maximum mean values of straw yield (ton/fed) were (2.698, 2.688) (2.360, 2.280) and (2.322, 2.322) ton /fed with Sakha 2, Giza 461 and Rina more at S_1 in the two seasons, respectively. While the mean values of straw yield at S_2 were (2.028 , 2.040), (1.98, 1.976) (1.966, 1.96) and (1.910, 1.908) with Sakha 2, Sakha 3, Giza 3 and Nobaria 1 in both seasons, respectively.

Also, at S_3 the maximum mean values were (1.896, 1.892) (1.89, 1.884) (1.862, 1.854) and (1.862, 1.848) with Sakha 3, Sakha 2 and Noburia 1) in both seasons respectively.

3.2.3 : Number of pods/plant :

Data in Table (4) show that the number of pods/plant significantly reduced by raising soil salinity level. The maximum values of number of pods /plant were (6.3, 5.8) and (5.5, 5.3) /plant for Giza 3, Sakha 2 at S_1 in both seasons respectively. While at S_2 the corresponding values were (4.8, 5.00) (4.5 , 4.8) (4.0 , 3.8) (4.3 , 3.5) for Sakha 2, Sakha 1, Sakha 3 and Giza 3, respecively. While at S_3 they were (4.0 , 4.0) (4.3 , 4.3) (3.5 , 3.3) (3.8 , 3.5 /plant) for Sakha 1, Sakha 2 and Sakha 3 and Giza 3 in the first and second seasons, respectively.

The investigated faba bean varieties can be arranged according to straw yield (ton/fed.) as follow :

With S_1 : Sakha 2 > Giza 461 = Rina More > Sakha 1 = Noburia 1 > Sakha 3 = Giza 3.

With S_2 : Sakha 2 = Sakha 3 > Giza 3 = Noburia 1 > Sakha 1 = Giza 461 = Rina More.

With S_3 : Sakha 2 > Noburia 1 = Giza 3 Sakha 3 > Sakha 1 > Giza 461 = Rina More.

Table (2): Some chemical properties of the tested soil* (0-60cm depth) after harvesting in both two seasons of 2006/2007 and 2007/2008.

Season	pH 1:2.5 Soil water suspension	Soil salinity range ECedSm^{-1}	Means of soluble ions – meq / L								SAR	Total N%	Available	
			Soluble cations meq/L				Soluble anions meq/L							
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3^{-}	CL^{-}	SO_4^{2-}			P mg kg^{-1}	K mg kg^{-1}
2006/ 2007	7.75	2: <4 (S1)	10.4	3.2	16.74	1.16	-	3.2	16.3	12	6.47	0.14	6.9	320
	7.90	4 : <6 (S2)	15.6	5.6	27.6	2.2	-	3.15	27.4	20.45	8.47	0.18	6.9	330
	8.16	6: <8 (S3)	20.7	10.6	35.4	3.3	-	5.4	34.1	31.5	8.94	0.19	7.0	360
2007/ 2008	7.80	2: <4 (S1)	10.2	2.9	15.2	1.2	-	3.1	14.8	11.6	5.93	0.16	6.7	310
	7.95	4 : <6 (S2)	14.9	5.8	26.2	2.1	-	3.2	24.3	21.5	8.14	0.17	6.8	340
	8.15	6: <8 (S3)	20.9	9.9	34.6	3.6	-	5.1	32.7	31.2	8.81	0.18	7.1	360

Table (3) : Effect of soil salinity range (s), faba bean varieties (v) and (s x v) interaction on studied characters during the two growth seasons

Variety	First season			Mean	Second season			Mean
	S1	S2	S3		S1	S2	S3	
	Seed yield Ardab/fed.							
Noburia	9.93 d	7.80 c	7.31 b	8.34	9.9de	7.74 bc	7.2 b	8.28
Giza 3	9.53 e	6.89 d	5.80 d	7.40	9.55 e	7.28 c	5.73 d	7.52
Giza 461	10.85 b	6.53 d	5.36 e	7.58	10.89 b	6.46 d	5.30 e	7.55
Sakha 1	10.45 c	7.70 c	7.03 b	8.59	10.47 bc	7.68 b	6.97 b	8.37
Sakha 2	12.13 a	10.05 a	9.13 a	10.43	12.22 a	10.08 a	9.09 a	10.46
Sakha 3	10.90 b	8.25 b	6.52 c	8.56	10.84 b	8.06 b	6.48 c	8.46
Rina More	10.20 cd	6.52 d	5.01 e	7.26	10.22cd	6.64 d	4.92 e	7.26
Mean	10.57	7.68	6.59		10.53	7.70	6.52	
	Straw yield (ton/faddan)							
Noburia 1	2.130 d	1.910 a	1.862 ab	1.967	2.226 bc	1.908 b	1.848 ab	2.03
Giza 3	1.900 e	1.966 a	1.890 a	1.918	1.894 e	1.960 ab	1.884 a	1.912
Giza 461	2.360 b	1.645 b	1.556 c	1.943	2.280 c	1.644 d	1.565 c	1.829
Sakha 1	2.196 cd	1.764 b	1.749 b	1.903	2.184 c	1.764 c	1.742 b	1.896
Sakha 2	2.698 a	2.028 a	1.862 ab	2.196	2.688 a	2.040 a	1.854 b	2.194
Sakha 3	1.996 e	1.980 a	1.896 a	1.957	2.018 e	1.976 ab	1.892 a	1.962
Rina Moro	2.322 bc	1.677 b	1.434 c	1.811	2.322 b	1.684 ed	1.428 d	1.811
Mean	2.228	1.852	1.748		2.230	1.853	1.744	

3.2.4. Number of seeds/plant :

Number of seeds/plant of faba bean varieties were significantly decreased with increasing soil salinity (Table 4). The highest number of seeds/plant were (24.44, 24.72) at S_1 for Giza 461 while at S_2 they were (16.34, 17.00) for Sakha 2. Also, at S_3 the maximum values were (14.92, 25.04) for Sakha 2 in the two seasons, respectively.

3.2.5: *Weight of 100-seeds (g) :*

Data presented in Table (4) show that, there is a significant decrease in weight of 100 seed of faba bean varieties caused by the increase of soil salinity levels. The maximum values of this growth parameter were (128.5, 128.75) (124.5, 125) and (120.5, 120 g) at S_1, S_2 and S_3 with Rina More 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, road length and shoot / root weight ratio. The results obtained here are in agree to a great extent, with those obtained by Yousef et al. (2008) who reported that salinity reduced the plant growth, pod, seed number and seed weight.

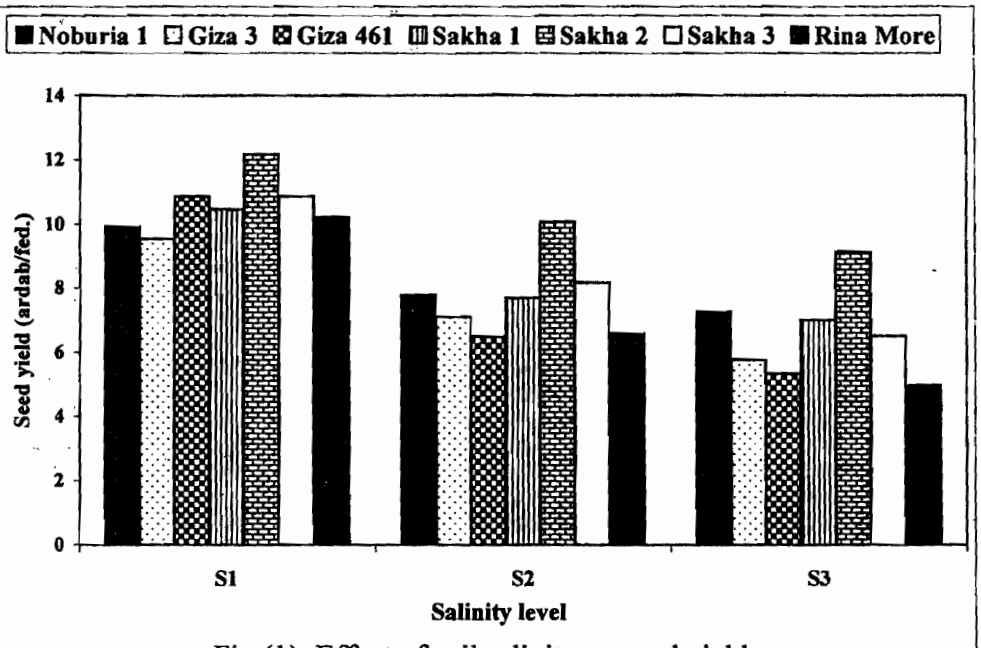

Fig (1): Effect of soil salinity on seed yield (ardab/fed.) of the investigated faba bean varieties .

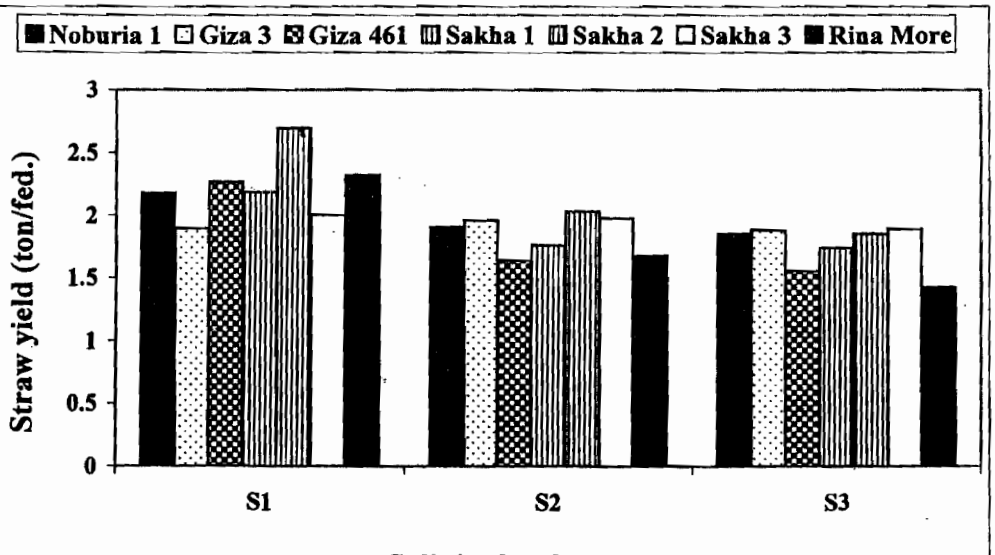

Fig (2): Effect of soil salinity on straw yield (ton/fed.) of the investigated faba bean varieties .

Table (4) : Effect of soil salinity range (s), faba bean 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	
	Number of pods/plant							
Noburia 1	4.5 cd	4.00 ab	3.3 bc	3.93	4.8 ab	4.0 bc	3.3 ab	4.03
Giza 3	6.3 a	4.3 ab	3.8 ab	4.80	5.8 a	5.5 a	3.5 ab	4.93
Giza 461	4.8 bc	3.8 b	2.8 cd	3.80	4.8 ab	4.0 bc	2.5 bc	3.77
Sakha 1	5.3 bc	4.5 ab	4.0 ab	4.060	5.3 a	4.8 abc	4.0 a	4.70
Sakha 2	5.5 ab	4.9 a	4.3 a	4.86	5.3 a	5.0 ab	4.3 a	4.87
Sakha 3	5.3 bc	4.0 ab	3.5 ab	4.26	5.0 ab	3.8 cd	3.3 ab	4.00
Rina More	3.8 d	2.8 c	2.0 d	2.87	4.0 b	2.8 d	2.0 v	2.93
Mean	5.07	4.04	3.38		5.00	4.27	3.27	
	Number of seed/plant							
Noburia 1	15.41 f	12.52 f	12.66 e	13.53	15.46 f	12.55 e	12.53 e	13.52
Giza 3	21.46 b	15.96 b	13.92 c	17.13	21.89 b	17.00 a	13.66 c	17.51
Giza 461	24.44 a	15.43 d	13.27 d	17.71	24.72 a	15.36 c	13.24 d	17.78
Sakha 1	19.89 d	15.31 e	14.03 b	16.43	19.81 d	15.40 c	13.97 b	16.43
Sakha 2	19.53 c	16.34 a	14.91 a	16.94	19.46 e	16.23 b	15.04 a	16.94
Sakha 3	20.48 c	15.60 c	12.51 f	16.19	20.31 c	15.21 d	12.49 f	16.01
Rina More	12.96 g	8.56 g	6.78 g	9.44	12.97 g	8.34 f	6.70 g	9.33
Mean	19.17	14.25	12.59		19.25	14.31	12.52	
	Weight of 100-seeds (g)							
Noburia 1	105.25b	100.37 b	94.25 c	99.95	104.5 b	100.00 b	94.00 c	99.5
Giza 3	72.5 e	70.5 c	68.00 f	70.33	71.25 e	70.00 e	68.5 f	69.91
Giza 461	72.58 e	69.08 e	66.00 f	69.22	72.00 e	68.75 e	65.25 g	68.67
Sakha 1	85.87 d	83.62 d	81.62 e	83.70	86.00 d	83.00 d	81.25 e	83.41
Sakha 2	101.5 c	100.5 b	99.75 b	100.58	101.5 c	100.5 b	98.75 b	100.25
Sakha 3	86.97 d	86.42 c	85.18 d	86.19	87.03 d	86.5 c	84.75 d	86.09
Rina More	128.5 a	124.5 a	120.5 a	124.5	128.75 a	125.00 a	120.0 a	124.58
Mean	93.31	90.71	87.9		93.00	90.53	87.50	

3.3: Protein concentration in seed of faba bean varieties under saline condition :

Data in Table (5) show the effect of soil salinity and faba bean varieties on protein % of faba bean. The results indicate that protein % decreased with increasing soil salinity for all faba bean varieties. Under the three levels of soil salinity Sakha 2 had the highest concentration of protein while the lowest concentration of protein% was with that of Giza 3. The reduction in N_2 –fixing activity by salt stress is usually attributed to a reduction in cytosolic protein production specifically leghemoglobin by nodules (Kapulmik *et al.*, 1989). In this respect, Rabie *et al.* (1986) found that the protein concentrations in seeds were depressed by all salinity levels. This is probably due to the higher % of both Na^+ and Cl^-. Youssef and Sprent

(1983) found that all salinity levels depreseed 100-seed weight and seed protein content.

3.4: Phosphorus and Potassium in seeds of faba bean varieties under saline condition :

As a general trend data presented in Table (5) showed that, P and K decreased with increasing soil salinity levels. The highest P and K concentrations were those of Sakha 2 while the lowest ones were those of Giza 3. Concentration and uptake values of P by plant organs decreased as salinity increased (El-Arquan *et al.* 1984). These results can be attributed to the effect of soil salinity on decreasing potassium absorpation and dry matter production. Similar results was obtained by El-Shafie and El.Shikha (2003).

Table (5) : Effect of soil salinity levels on protein content, phosphorus and potassium % in seeds of faba bean varieties

Variety	Protein %			P %			K %		
	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
Noburia 1	24.25 b	24.00 b	20.38 c	0.43 b	0.40 b	0.40 a	2.72 d	2.68 d	2.26 d
Giza 3	18.75 g	18.63 f	16.13 f	0.29 c	0.26 c	0.22 c	2.22 e	2.00 f	1.76 f
Giza 461	21.81 d	20.63 d	20.38 c	0.41 a	0.36 a	0.33 ab	2.86 cd	2.68 c	2.36 d
Sakha 1	20.25 f	20.13 e	19.13 e	0.36 b	0.34 b	0.31 c	2.86 cd	2.68 d	2.36 d
Sakha 2	26.75 a	26.44 a	26.14 a	0.42 a	0.40 a	0.38 ab	3.6 a	3.72 a	3.24 a
Sakha 3	22.63 c	22.5 c	22.25 b	0.42 a	0.36 b	0.36 b	3.38 b	3.40 b	3.02 b
Rino	20.94 e	20.88 d	19.69 d	0.40 a	0.39 ab	0.35 b	2.28 e	2.24 e	2.04 e
Mora									

*** Seed protein = Equal to nitrogen content of seeds x 6.25**

3.5: Guideline for tolerant faba bean 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 in saline soil is compared with its absolute yield with a normal soil. the salt level of soil causing a 25% yield reduction is taken as the tolerable soil salt level for the given crop (FAO, 1985). Data of relative yield decrement of faba bean varieties as influenced by different levels of soil salinity are shown in Table (6).

Table (6) : Regression equations for relative yield decrements and values of soil salinity that cause these decrement for different faba bean varieties

Variety	y = a x + b	ECe caused 25% dS/m
Noburia 1	y = 5.909 x -10.488	6.00
Giza 3	y = 8.3395 x -16.647	4.99
Giza 461	y = 10.491 x -17.027	4.00
Sakha 1	y = 6.9583 x -5.8831	4.43
Sakha 2	y = 5.741 x -10.297	6.15
Sakha 3	y = 8.7117 x -19.578	5.12
Rina More	y = 10.425 x -17.833	4.11

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 (6) gives a guide line introduced by FAO (1985) for the effect of soil salinity on relative yield decrement of faba bean varieties grown on Kafr El-Sheikh soils. It could be concluded that the values of ECe which cause 25% reduction of yield were 6.15 and 6.00 dS/m for Sakha 2 and Nobaria 1. The corresponding values were 4.00, 4.11 dS.m for Giza 461 and Rina More.

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الملخص العربي

تحمل بعض أصناف الفول لمستويات مختلفة من ملوحة التربة

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أجريت تجربتان حقليتان بمحطة البحوث الزراعية بسخا – كفر الشيخ خلال موسمي ٢٠٠٦ /٢٠٠٧ و ٢٠٠٧ / ٢٠٠٨ 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 الفول وهى نوبارية ١ ، جيزة ٣ ، جيزة ٤٦١ ، سخا ١ ، سخا ٢، سخا ٣ وصنف رينامور . وكان التصميم الإحصائى المستخدم هو Split Plot Design حيث كانت القطع الرئيسية تمثل مستويات ملوحة التربة والقطع تحت الرئيسية (سبعة أصناف من الفول).

وقد أظهرت النتائج مايلى :

* تأثرت كل الأصناف تحت الدراسة بمستويات ملوحة التربة المختلفة بتأثيرها على المحصول ومكوناته.

* تأثر محصول البذور (أردب / فدان) بملوحة التربة لكل الأصناف وأخذ الترتيب التالى مع مستويات ملوحة التربة المختلفة تحت الأول S_1 : كان سخا ٢ > سخا ٣ = جيزة ٤٦١ > سخا ١ = رينامور > نوبارية ١ > جيزة ٣. ومع مستوى الملوحة الثانى S_2 : سخا ٢ > سخا٣ > نوبارية ١ = سخا ١ > جيزة ٣ = جيزة ٤٦١ = بينما عند مستوى الملوحة S_3 : كان الترتيب سخا ٢ > نوبارية ١ = سخا ١ > سخا ٣ > جيزة ٣ > جيزة ٤٦١ = رينامور .

* زيادة ملوحة التربة أدت إلى نقص محصول القش (طن / فدان) وعدد القـرون / نبات وعدد بذور / نبات ووزنه مائة بذرة.

* أظهرت أصناف سخا ٢ ونوبارية ١ تحمل أكثر لملوحة التربة بينما الأصـناف جيزة ٤٦١ وريناامور كانت أكثر حساسية لملوحة التربة بينما الأصناف سـخا ٣ وسخا ١ كانت متوسطة التحمل للملوحة طبقاً للـ FAO (١٩٨٥).

* تأثر محتوى بذور أصناف الفول من تركيز البروتين والفوسـفور والبوتاسـيوم بمستويات الملوحة معنوياً حيث كان تركيز البروتين والفوسفور والبوتاسـيوم % الأعلى فى صنف سخا ٢ مقارنة بالأصناف الأخرى.