

Effect of Salinity and Drought Stress on Potassium Uptake in *Musa* Spp *in vitro*

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Abstract

The study was executed from the period of 2014 to 2015 seasons at the tissue culture laboratory of the Horticulture department, Faculty of Agriculture – Assiut University *In vitro* grown banana plantlets of Grand Nain and Zeev cultivars were treated with NaCl at 0,30,60,120, and 200 mM/L to study the effect of salinity stress on the plantlets or with PEG at 0,10,20,30, and 40g/L for drought investigation. The obtained results could be concluded as follow:

1-Effect of salinity: Plantlet height, fresh weight, dry weight and number of leaves/plantlet significantly decreased by increasing the NaCl concentration from Zero to 200 mM/L for both tested cultivars during 2014 and 2015 season. Total chlorophyll and K⁺ content significantly decreased, while sodium content significantly increased by increasing NaCl concentrations as compared with untreated plantlets (control).

2- Effect of drought: The effect of PEG at different concentrations took approximately the same tendency as NaCl concentrations concerning the vegetative and chemical characteristics of both Grand Nain and Zeev plantlets during both investigated seasons.

Keywords: *in vitro* – banana – salinity – drought – polyethlen glycol.

Introduction

Bananas (*Musa spp.*) belong to the family Musaceae they are one of the world's most important subsistence crops. It is originated in Malaysia through a complex hybridization process (Novak, 1992). It is one of the most important cash crops in the world and has high acceptability amongst consumers. In addition, it is considered as main source of food that is rich in carbohydrate, minerals, phosphorus, calcium, potassium and vitamin-C. Furthermore, it is a chief producer of tannins, latex and fibers.

Commercial yield of banana is being lost by a number of variable environmental stresses. Among the abiotic stresses, excessive saline conditions of the soil causes loss of both vegetative potential and yield. (Neu-

mann,1997). Many biotic and abiotic factors are responsible for low yield and production of banana in Egypt. Among the stress conditions, salinity is one, which has a serious effect on plant micro-propagation rate. It is not effective only under natural but also under in-vitro conditions (Misra *et al.*, 1990; Neumann. 1997; wang *et al.* 2003 and wakeel 2013).

Plants subjected to abiotic stress use various defense mechanisms to cope with the stress. A common strategy is the synthesis and accumulation of osmoprotectants or compatible solutes like proline, glycine betaine, polyamines or trehalose. Tolerance to abiotic stresses can be acquired by pre-treatment with such a protective compound (Stolker, 2010).

Drought stress-induction is one of the most popular approaches that takes use of high molecular weight osmotic agents, such as Polyethylene Glycol (PEG) (Turkan *et al.*, 2005 and Landjeva *et al.*, 2008). These agents have no detrimental or toxic effects on the plant (Ober and Sharp, 2003); however, they inhibit the plant growth by lowering the water potential of the culture medium in a way similar to soil drying, so that cultured explants are unable to take up water (Matheka *et al.*, 2008).

Similarly, drought requires proper understanding for better plant growth. It causes deficit water supply to the growing plants. Meanwhile, salinity causes inhibitory effects on plant growth because of the toxicity of excessive Na⁺ and Cl⁻ to the absorbance of water. It can be attributed to decrease in availability of the water required or imposed by developed osmotic stress (Djibril *et al.*, 2005 and Munns *et al.*, 2006).

Therefore, according to the above mentioned facts, the present study was undertaken with the following objectives

1-To study the effect of NaCl and PEG on *invitro* propagation and vegetative characteristics of Zeev and Grand Nain cultivars.

2-To determine the K⁺ uptake under salinity and drought stress of Zeev and Grand Nain cultivars.

Materials and Methods

This study was executed during the period from 2014 to 2015 at the tissue culture laboratory of Horticulture Dept., Faculty of Agriculture, Assiut University.

Plant material and growth conditions:

Two (*Musa spp.*) banana cultivars namely Grand Nain (G) and Zeev (Z) grown *in vitro* were used in this study as explants. The propagated plants were subcultured every 6 weeks for multiplication in 500 ml culture jars contained MS medium (Murashigae and Skoog, 1962) Table 1. The medium was supplemented with 0.1g/L myo-inositol, 30 g/l sucrose and 3 mg/l 6-Benzylaminopurine (BAP) for proliferation, and solidified with 2 g/L gelrite at pH 5.8 to 6 and had been sterilized by autoclaving for 20 min at 121°C and 15 lb/in². The cultured explants were incubated in a controlled environment (25±1°C, 16 h photoperiod, 2200 lux light intensity, 75±5% humidity).

Tolerance experiment:

In this experiment, each of the two above mentioned cultivars were subcultured on media each on contained one of the two osmotic agents:

1-Sodium chloride (NaCl) at 0,30,60,120 and 200 mM/L .

2- Polyethylene glycol (PEG 600) at 0,10,20,30 and 40 g/L .

Measurements Taken:

Data samples were collected after 6 weeks for each experiment, plantlets were washed up from the agar or media residues with sterilized water and the following traits were measured for all experiments:

A) Vegetative Parameters: were measured as fresh plants, which were later, dried at 75 °C for 22 h and 110 °C for 2 h. The vegetative parameters were; plantlet height (cm), average number of leaves/explant and plantlets fresh and dry weight (g).

B) Physiological Parameters:

1-Total chlorophyll: Leaves were collected from the mid-section of the plantlets in order to minimize leaf age variability effects. Chlorophyll was measured with SPAD-502 equipment (Minolta Camera Co. Ltd., 1989). Chlorophyll was measured as SPAD unit.

2-Potassium and Sodium contents: Plantlets were collected, oven-

dried at 75 °C for 22 h and 110 °C for 2 h and grounded. Samples of 0.2 g from each plantlet were digested according to (Jackson,1973) and K⁺ and Na⁺ contents were determined by flame photometry (Digital Flame Analyzer, Cole Parmer, Illinois, USA).

Table 1. Murashige and Skoog (MS) basal medium (mg/L).

Group	Compound	Murashige and Skoog (MS)
A	NH ₄ NO ₃	1650
	KNO ₃	1900
	Ca(NO ₃) ₂ .4H ₂ O	--
B	K ₂ SO ₄	--
	MgSO ₄ .7H ₂ O	370
	MnSO ₄ .4H ₂ O	22.3
	ZnSO ₄ .7H ₂ O	8.6
	CuSO ₄ .5H ₂ O	0.025
	(NH ₄) ₂ SO ₄	--
C	CaCl ₂ .2H ₂ O	440
	KI	0.83
	CoCl ₂ .6H ₂ O	0.025
D	KH ₂ PO ₄	170
	H ₃ BO ₃	6.2
	Na ₂ MoO ₄ .2H ₂ O	0.25
	NaH ₂ PO ₄ .H ₂ O	--
E	FeSO ₄ .7H ₂ O	27.84
	Na ₂ .EDTA	37.3
F	Thiamin.HCl	1
	Nicotinic acid	0.5
	Pyridoxine HCl	0.5
	Glycine	2
G	Myo-inositol	0.1

- Adenine sulfate was added at 80 mg/L.

Statistical analysis:

This experiment was designed as a factorial experiment, means separation were made according to the least significant differences (L.S.D) at 5% Level (Steel and Torrie, 1980).

Results and Discussions

I: Effect of salinity stress exposed to NaCl:

I-1: Effect of salinity on vegetative parameters:

I:1-1: Effect of salinity (NaCl mM/L) on plantlet height :

In general, the obtained results in Table (2) took approximately the same trend during both experimental seasons. The obtained data indicated also that the average plantlet height gradually and significantly decreased by increasing NaCl concentration from zero to 200 mM/L. The highest values of plantlet height were occurred by control treatment (zero NaCl) in both tested cultivars Grand Nain recorded 8.33 and 10.00 cm and Zeev 12.00 and 8.70 cm during the two experimental seasons, respectively. While the lowest values of plantlet height were recorded when using 200 mM/L NaCl Grand Nain cv. recorded 2.63 and 4.00 cm and Zeev cv 4.90 and 5.03 in both seasons, respectively.

I-1-2: Effect of salinity (NaCl mM/L) on average number of leaves:

The obtained data in Table (2) indicated that, the average number of leaves /plantlet of both tested cvs. were significantly decreased by increasing NaCl concentration from zero to 200 mM/L during the two seasons. The average number of leaves /plantlet of Grand Nain cv decreased from 5.33 and 5.67 Leaf /Plantlet to 4.00 and 4.33 leaf/plantlet by applying zero and 200mM/L NaCl during both investigated seasons, respectively. Concerning Zeev cv. the highest number of leaves/plantlet (7.33 and 7.33) was found in the control treatment (zero NaCl) while the lowest average number (2.33 and 4.33) was recorded with 200mM/L NaCl treatment during both seasons, respectively.

Table 2. Effect of salinity (NaCl mM/L) at different concentrations on plantlet height and Number of Leaves of Grand Nain (G) and Zeev (Z) banana cultivars planted on MS medium during 2014 and 2015 seasons.

Characters		Average plantlet height (cm)						Average Number of Leaves/plant						
		2014			2015			2014			2015			
		G	Z	Mean	G	Z	Mean	G	Z	Mean	G	Z	Mean	
Treatments mM/L		Zero	8.83	12.00	10.42	10.00	8.70	9.35	5.33	7.33	6.30	5.67	7.33	6.50
		30	6.83	10.00	8.42	8.87	8.03	8.45	5.33	7.00	6.17	5.67	6.00	5.84
		60	6.53	10.17	8.35	6.83	6.37	6.60	5.00	5.33	5.17	5.67	6.67	6.17
		120	4.83	8.17	6.50	5.83	5.33	5.58	5.33	4.00	4.67	5.00	6.00	5.50
		200	2.63	4.90	3.77	4.00	5.03	4.56	4.00	2.33	3.16	4.33	4.33	4.33
		Mean	5.93	9.05	----	7.11	6.69	----	4.99	5.20	----	5.27	6.07	----
LSD	A:(Cultivars)	2.34			NS			2.34			NS			
	B:(Treatments)	1.55			1.18			0.93			1.02			
	AB:(Interaction)	NS			NS			1.31			NS			

I-1-3-Effect of salinity (NaCl mM/L) on fresh weight:

Concerning the fresh weight of plantlet, it was found that with increasing the applied NaCl concentration from zero to 200 mM/L plantlet

fresh weight significant decreasing of the two investigated cultivars Table (3).

The obtained results showed also that untreated Grand Nain and Zeev plantlet (Zero NaCl) had the

highest values of fresh weight (1.35 g for Grand Nain and 1.97 g for Zeev cv) during the first season. While 30 mM/L NaCl gave the highest values (1.53 g for Grand Nain and 1.33 g for Zeev cv in the second season.

I-1-4: Effect of salinity (NaCl mM/L) on dry weight:

The obtained results of plantlet dry weight took approximately the similar tendency as those of fresh weight in both studied cultivars during the two seasons (Table 3).

Data in previous table revealed that there was a significant effect of salinity treatments on average dry weight of both tested cultivars. All NaCl concentrations (except 30 ml/L with Grand Nain cv.) significantly decreased the average dry weight /plantlet and the lowest values were found by 200mM/L NaCl in Grand Nain cv (0.04, 0.02 g) and (0.05, 0.04 g) in Zeev cv. during the two experimental seasons, respectively.

Table 3. Effect of salinity (NaCl mM/L) at different concentrations on Fresh and Dry weight (g) of Grand Nain and Zeev banana cultivars planted on MS medium during 2014 and 2015 seasons.

Characters		Average fresh weight (g)						Average dry weight (g)					
		2014			2015			2014			2015		
		G	Z	Mean	G	Z	Mean	G	Z	Mean	G	Z	Mean
Treatments mM/L													
Zero		1.35	1.97	1.66	1.33	1.00	1.17	0.07	0.10	0.09	0.10	0.10	0.10
30		1.33	1.89	1.61	1.53	1.13	1.33	0.08	0.10	0.09	0.12	0.07	0.10
60		1.03	1.29	1.16	0.97	0.73	0.85	0.06	0.10	0.08	0.08	0.06	0.07
120		0.60	0.98	0.79	0.43	0.60	0.52	0.07	0.09	0.08	0.06	0.05	0.06
200		0.38	0.34	0.36	0.23	0.50	0.73	0.04	0.05	0.05	0.02	0.04	0.03
Mean		0.94	1.30	----	0.90	0.79	----	0.06	0.09	----	0.08	0.06	----
LSD	A:(Cultivars)	NS			NS			NS			NS		
	B:(Treatments)	0.37			0.39			0.02			0.02		
	AB:(Interaction)	NS			NS			NS			NS		

I-1-5: Effect of salinity (NaCl mM/L) on total chlorophyll content

In general the obtained results in Table (4) indicated that, all NaCl treatments significantly decreased that total chlorophyll content in both tested cultivars plantlet comparing with control during 2014 to 2015 seasons.

Moreover the highest values of chlorophyll content were found in the untreated plantlet (zero NaCl) of Grand Nain cv. (31.03 and 25.45 mg/100 F.w) during both investigated seasons, respectively.

On the other hand, 200 mM of NaCl gave the lowest values of chlo-

rophyll content in Grand Nain plantlet (6.83 and 5.10 mg/100 gF.w) and Zeev cv. (7.87 and 4.70 mg/100 g F.w.) during both tested seasons, respectively.

The obtained results are in agreement with these found by Neumann, 1997; Misra *et al.* 1990; wang *et al.* 2003.; Gomes *et al.*2004.; Hu and Schmidhalter, 2005.; Silva *et al.* 2009; Ikram-ul-Haq *et al.* 2011; Bidabadi *et al.* 2012; Gholizadeh *et al.* 2012.; Belfakih *et al.* 2013.; Kaushal *et al.* 2012 and wakeel 2013.

Table 4. Effect of salinity (NaCl mM/L) at different concentrations on total chlorophyll of Grand Nain and Zeev banana cultivars planted on MS medium during 2014 and 2015 seasons.

Character Treatments mM/L		Average total chlorophyll (mg/100 g fresh weight)					
		2014			2015		
		G	Z	Mean	G	Z	Mean
Zero		31.03	26.63	28.83	25.45	27.61	26.53
30		21.73	19.30	20.52	22.37	21.91	22.14
60		21.03	12.90	16.97	18.04	18.01	18.03
120		10.73	6.80	8.77	10.45	9.35	9.90
200		6.83	7.87	7.35	5.10	4.70	4.90
Mean		18.27	14.70	----	16.28	16.32	----
LSD 0.05%	A:(Cultivars)	NS			NS		
	B:(Treatments)	6.29			1.12		
	AB:(Interaction)	NS			NS		

I-2- Effect of salinity on nutritional status:

I-2-1- Effect of salinity (NaCl mM/L) on potassium(K) content:

Generally, all NaCl concentrations significantly decreased potassium (K) content in the plantlet of both cultivars compared with control (Table 5). The highest values of K content were found in the untreated (control) plantlet of Grand Nain gave 5.47 and 5.25 % and Zeev 4.87 and 5.50 % during the two seasons, respectively. On the other hand, the lowest K percentages were recorded by application the highest concentration of NaCl (200 mM/L) where Grand Nain cv. gave 0.95 and 1.30 % and Zeev cv. 1.19 and 1.49 % during 2014 and 2015 seasons respectively.

Moreover, no significant differences were found between Grand Nain and Zeev banana cultivars concerning k content as affected by different concentrations of NaCl.

I-2-2-Effect of salinity (NaCl mM/L) on Sodium content %:

The obtained data in the previous Table (5) indicated that plantlet sodium (Na) content took contrary trend of potassium (K) content in both tested cultivars during the two seasons. Additionally, the obtained data had approximately the same trend during both seasons.

Moreover it could be suggest that sodium (Na) % significantly increased by increasing the applied NaCl concentration. Meaning that the highest values of Na content were found in the plantlet of Grand Nain (2.64 and 3.15) and (2.24 and 3.02) in Zeev cv. by using 200 mM/L NaCl during the two seasons, respectively, meanwhile the lowest Na contents were recorded in untreated plantlet (zero NaCl) of Grand Nain (0.25 and 0.21 %) and Zeev cv. (0.24 and 0.85) in both 2014 and 2015 seasons, respectively.

Thes results are in the line with those obtained by Gomes Eline *et al.* 2004; Ikram-ul-Haq *et al.* 2011; Gholizadeh *et al.* 2012. and Kaushal *et al.* 2013.

Table 5. Effect of salinity (NaCl mM/L) at different concentrations on potassium % and sodium % of Grand Nain and Zeev banana cultivars planted on MS medium during 2014 and 2015 seasons.

Characters Treatments mM/L		Average Potassium %						Average sodium %					
		2014			2015			2014			2015		
		G	Z	Mean	G	Z	Mean	G	Z	Mean	G	Z	Mean
Zero		5.47	4.87	5.17	5.25	5.50	5.38	0.25	0.24	0.25	0.21	0.85	0.53
30		4.97	4.61	4.79	5.27	4.93	5.10	0.48	0.70	0.59	0.95	0.70	0.83
60		4.00	4.17	4.09	2.63	3.67	3.15	1.07	0.89	0.98	1.93	1.94	1.94
120		2.63	2.50	2.57	2.40	3.37	2.89	2.00	2.12	2.06	2.50	2.26	2.38
200		0.95	1.19	1.07	1.30	1.49	1.40	2.64	2.24	2.44	3.15	3.02	3.09
Mean		3.60	3.47	----	3.37	3.80	----	1.29	1.24	----	1.75	1.75	----
LSD 0.05%	A:(Cultivars)	NS			NS			NS			NS		
	B:(Treatments)	0.26			0.28			0.14			0.48		
	AB:(Interaction)	0.37			0.39			0.20			NS		

I I: Effect of drought stress exposed to PEG:

II-1: Effect of drought on vegetative parameters:

II:1-1: Effect of drought (PEG g/L) on plantlet height :

Generally, similar response to the PEG treatments was found in both cultivars during 2014 and 2015 seasons (Table 6).

It is also clear to notice that the average plantlet height of both cultivars gradually and significantly decreased with increasing the concentration of PEG treatments during the two tested seasons. Moreover all PEG treatments significantly decreased the average plantlet height of Grand Nain and Zeev banana cvs. during the two seasons as compared with control plantlet (zero PEG).

The highest values of plantlet height were 8.33 and 10.00 cm for Grand Nain cv and (12.00 and 8.70 cm) for Zeev cv. such values were

recorded in untreated plantlet (zero PEG) during both investigated seasons, respectively.

I I -1-2: Effect of drought (PEG g/L) on number of the leaves:

The obtained results took (Table 6) approximately the same trend during 2014 and 2015 seasons for the both tested cultivars. All PEG concentration significantly reduced the average number of leaves/plantlet compared to the control treatment (zero PEG). so that the untreated plantlet produced the highest leaves number (5.33 TO 5.67) for Grand Nain cv and (7.33 TO 7.33) for Zeev cv. during both seasons, respectively.

Moreover the average number of leaves/plantlet gradually decreased by increasing the applied PEG concentration and reached its minimum values by 40 g PEG (4.87 and 5.60) for Grand Nain cv and (5.94 and 5.93) for Zeev cv in 2014 and 2015 seasons, respectively.

Table 6. Effect of drought (PEG g/L) at different concentrations on plantlet height and number of leaves of Grand Nain and Zeev banana cultivars planted on MS medium during 2014 and 2015 seasons.

Characters Treatments g/L		Avearge plantlet height (cm)						Avearge number of leaves/plant					
		2014			2015			2014			2015		
		G	Z	Mean	G	Z	Mean	G	Z	Mean	G	Z	Mean
Zero		8.83	13.00	10.92	10.00	8.70	9.35	5.33	7.33	6.33	5.67	7.33	6.50
10		7.00	5.00	6.00	7.50	6.50	7.00	5.00	6.33	5.67	6.00	6.67	5.34
20		6.17	5.50	5.84	6.17	5.33	5.75	4.67	6.00	5.34	6.00	5.67	5.84
30		5.83	5.83	5.83	4.50	4.67	4.59	4.67	5.00	4.84	5.33	5.33	5.33
40		5.50	4.17	4.84	4.33	4.27	4.30	4.67	5.00	4.84	5.00	4.67	4.84
Mean		6.67	6.70	----	6.50	5.90	----	4.87	5.94	----	5.60	5.93	----
LSD 0.05%	A:(Cultivars)	NS			NS			NS			NS		
	B:(Treatments)	1.21			1.03			0.83			1.01		
	AB:(Interaction)	1.71			NS			NS			NS		

II:1-3-Effect of drought (PEG g/L) on fresh weight:

It is clear to notice that, the average fresh weight of both investigated cultivar showed similar tendency for negative response to drought (PEG) and took approximately the same trend during both seasons in Table (7).

The average fresh weight of untreated plantlet had the highest values. The fresh weight recorded 1.35 and 1.33 g for Grand Nain cv and 1.97 and 1.02 g for Zeev cv. during both tested cultivars, respectively. With increasing the applied PEG concentrations from Zero to 40 g it gradually reduced the average fresh weight and reached the minimum values by using 40 of PEG 0.64 and 0.57 g for Grand Nain cv. and (0.50 and 0.28) for Zeev plantlet during the

two investigated seasons, respectively.

II:1-4:Effect of drought (PEG g/L) on dry weight (g):

The obtained data indicated that similar tendency was found concerning fresh and dry weight of both studied cultivars during both experimental seasons (Table7).

The highest dry weight (0.09 and 0.10 g) and (0.10 and 0.08 g) was found in untreated plantlet (Zero PEG) for both tested cultivars during 2014 and 2015 seasons, respectively.

On the other hand, increasing PEG concentration up to 40g produced the lowest values of dry weight (0.06 and 0.05 g) for Grand Nain cv. and (0.05 and 0.03 g) for Zeev plantlet during both tested seasons, respectively.

Table 7. Effect of drought (PEG g/L) at different concentrations on fresh weight (g) and dry weight(g) of Grand Nain and Zeev banana cultivars planted on MS medium during 2015 and 2016 seasons.

Characters Treatments g/L		Average fresh weight(g)						Average dry weight(g)					
		2014			2015			2014			2015		
		G	Z	Mean	G	Z	Mean	G	Z	Mean	G	Z	Mean
Zero		1.35	1.97	1.66	1.33	1.02	1.18	0.09	0.10	0.10	0.10	0.08	0.09
10		0.97	0.71	0.84	0.83	0.79	0.81	0.08	0.06	0.07	0.06	0.08	0.07
20		0.85	0.63	0.74	0.53	0.68	0.61	0.07	0.06	0.07	0.08	0.07	0.08
30		0.74	0.60	0.67	0.53	0.60	0.57	0.06	0.05	0.06	0.06	0.05	0.06
40		0.64	0.50	0.57	0.47	0.28	0.38	0.06	0.05	0.06	0.05	0.03	0.04
Mean		0.91	0.89	----	0.74	0.67	----	0.07	0.06	----	0.07	0.06	----
LSD 0.05%	A:(Cultivars)	NS			NS			NS			NS		
	B:(Treatments)	0.32			0.23			NS			0.02		
	AB:(Interaction)	0.45			NS			NS			NS		

II:1-5-Effet of drought (PEG g/L) on total chlorophyll content :

Significant decrease in the chlorophyll content was occurred in the plantlet of both tested cultivars during 2014 and 2015 by all PEG treatments as compared with control (Zero PEG) (Table 8).

So that the highest values of total chlorophyll content (31.03 and 25.07 mg/100mg F.w) for Grand Nain cv. and (26.63 and 31.00) for Zeev cv. were recorded in the untreated plantlets (Zero PEG).

Moreover the plantlets content of total chlorophyll gradually de-

creased by increasing the applied concentration of PEG in the both tested cultivars and reached the minimum values (16.37 and 16.23 mg/100g) Grand Nain cv. and (15.13 and 16.20 mg/100 F.W) in Zeev cv. by using 40g PEG concentration during both experimental seasons, respectively.

These results agree with the findings of Hu and Schmidhalter, 2005.; Matheka *et al*, 2008.; Stolker, 2010; Bidabadi *et al*. 2011; Ikram-ul-Haq *et al*. 2011; Placide *et al*. 2012 ;and Said. *et al*. 2015.

Table 8. Effect of drought (g PEG/L) at different concentrations on total chlorophyll of Grand Nain and Zeev banana cultivars planted on MS medium during 2 seasons.

Character Treatments g/L		Average total chlorophyll (mg/100 g fresh weight)					
		2014			2015		
		G	Z	Mean	G	Z	Mean
Zero		31.03	26.63	28.83	25.07	31.00	28.04
10		18.93	18.85	18.89	19.67	19.33	19.50
20		17.07	18.67	17.87	18.83	19.30	19.07
30		16.70	18.23	17.47	17.37	17.23	17.30
40		16.37	15.13	15.75	16.23	16.20	16.22
Mean		20.02	19.50	----	19.43	20.61	----
LSD 0.05 %	A:(Cultivars)	NS			NS		
	B:(Treatments)	5.55			7.39		
	AB:(Interaction)	NS			NS		

II:2- Effect of drought (PEG g/L) on nutritional status:-

II:2-1 Effect of drought (PEG g/L) on potassium% content :-

Generally, data in the previous Table (9) indicated that potassium content (K^+ %) ranged from 1.60 to 5.47 % and the results took approximately the same tendency for both tested cultivars during 2014 and 2015 seasons.

The highest contents of K^+ % were measured in the untreated plantlet (Zero PEG) for Grand Nain cv (5.47 and 5.25%) and for Zeev (5.17 and 5.50%) as compared with other PEG treatments during both studied seasons, respectively.

Moreover, the potassium content significantly decreased by increasing the concentration of PEG and reached its minimum content by using 40 g of PEG (3.03 and 1.60%) in Grand Nain cv and (2.30 and 3.15%) in Zeev plantlet during 2014 and 2015 seasons, respectively.

II:2-2- Effect of drought (PEG g/L) on sodium% content:

The obtained results indicated that similar tendency was found during both tested seasons concerning

the effect of different concentrations of PEG on sodium (Na^+ %) in Grand Nain and Zeev banana plantlets Table (9) .

The percentage of sodium (Na^+ %) gradually and significantly increased by increasing PEG concentration in the plantlets of both tested cultivars and reached its maximum values with 40 g PEG (0.88 and 40%) for Grand Nain cv and (0.33 and 0.21%) for Zeev cv. during both investigated seasons, respectively.

On the other hand, the lowest values of sodium% were found in the untreated (Zero PEG) plantlets of Grand Nain (0.25 and 0.21 %) and Zeev cv. (0.24 and 0.19%) during 2014 and 2015 seasons, respectively.

Moreover, significant differences were found among the response of the tow tested cultivar to the different concentration of PEG concerning the sodium% in the plantlets, during both studied seasons.

Similar results were reported by Ober and Sharp, 2003., Matheka *et al.*, 2008., Placide *et al.* 2005., Stolker, 2010, Ikram-ul-Haq *et al.* 2011,. Said, Eglal. M. *et al.* 2012 and Hu and Schmidhalter, 2015.

Table 9. Effect of drought (PEG g/L) at different concentrations on potassium% and sodium% of Grand Nain and Zeev banana cultivars planted on MS medium during 2014 and 2015.

Characters Treatments g/L		Average Potassium %						Average Sodium %					
		2014			2015			2014			2015		
		G	Z	Mean	G	Z	Mean	G	Z	Mean	G	Z	Mean
Zero		5.47	4.87	5.17	5.25	5.50	5.38	0.25	0.24	0.25	0.21	0.19	0.20
10		4.75	4.50	4.63	4.90	4.65	4.78	0.25	0.21	0.23	0.18	0.17	0.18
20		4.50	3.23	3.87	3.75	4.25	4.00	0.30	0.27	0.29	0.18	0.18	0.18
30		3.72	2.98	3.35	2.50	3.25	2.88	0.33	0.30	0.31	0.20	0.18	0.19
40		3.03	2.30	2.67	1.60	3.15	2.38	0.88	0.33	0.61	0.40	0.21	0.31
Mean		4.30	3.60	----	3.60	4.16	----	0.40	0.27	----	0.23	0.19	----
LSD 0.05%	A:(Cultivars)	0.21			0.16			0.04			0.02		
	B:(Treatments)	0.30			0.17			0.04			0.02		
	AB:(Interaction)	0.42			0.24			0.05			0.03		

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تأثير الملوحة والجفاف على امتصاص البوتاسيوم في الموز معمليا

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الملخص

أجريت هذه الدراسة بمعامل زراعة الأنسجة بقسم الفاكهة - كلية الزراعة - جامعة أسيوط خلال موسمي ٢٠١٤ ، ٢٠١٥ م وذلك لدراسة تأثير الملوحة والجفاف على النمو وامتصاص عنصر البوتاسيوم لصنفى الموز جرانندان وزيف.

لدراسة تأثير الملوحة تم معاملة نباتات الموز النامية فى بيئة موراشيخ وسكوج بتركيزات مختلفة من كلوريد الصوديوم صفر، ٢٠٠، ١٢٠، ٦٠، ٣٠ ملليمول/لتر ، ولدراسة تأثير الجفاف تم إضافة تركيزت صفر ، ١٠، ٢٠، ٣٠، ٤٠ جرام/لتر من البولى ايتلين جليكول.

تم أخذ بعض القياسات على النباتات المعاملة من صنفى الموز وكانت أهم النتائج المتحصل عليها كالتالى:

اولا: الملوحة

- أدى استخدام تركيزات مختلفة من كلوريد الصوديوم الى نقص معنوي فى الصفات الخضرية للنباتات لكلا من الصنفى وهى الطول والوزن الطازج والجاف وعدد الاوراق لكل نبتة وقد زاد النقص بزيادة تركيز الملوحة.

- حدث نقص معنوي فى كمية البوتاسيوم وكذلك نسبة الكلوروفيل باستخدام التركيزات المختلفة من كلوريد الصوديوم بينما زاد محتوى النباتات من عنصر الصوديوم.

ثانيا: الجفاف

كانت استجابة نباتات صنفى الموز جرانندان وزيف للمعاملة بالبولى ايتلين جليكول مشابهة تقريبا للمعاملة بتركيزات كلوريد الصوديوم حيث نقصت طول ووزن النباتات وعدد الاوراق بها وكذلك امتصاص عنصر البوتاسيوم ونسبة الكلوروفيل بينما زادت تركيزات الصوديوم بزيادة تركيز البولى ايتلين جليكول المستخدم.