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EFFECT OF DIFFERENT IRRIGATION WATER SALINITY ON GERMINATION , GROWTH AND CELL MEMBRANE STABILITY OF CORN PLANT (*Zea mays* l .)

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SUMMARY

The effect of four different types of irrigation water were studied for some morphological and physiological parameters of corn plant (*Zea mays* L.) Rabbi variety . Velocity and percentage of germination and plant growth were reduced upon saline irrigation water treatments (drainage and ground water) . There was an increase of sodium ions in plant content and a decrease of potassium ions content with the increase of sodium concentration in irrigation water . Also , saline irrigation water (drainage and ground water) showed a high level of leaf solutes leakage with high level of root cells relative injury as compared with non saline medium . Results indicated that the damage of cell membrane was due to the high level of salinity which increased the sodium ions of plant content against a decrease of potassium ions content

Key word :- Salinity , Corn plant , Plasma membrane

Introduction

The high salinity in growth media retards the growth of most crops (1, 2, 3 and 4) . There were many effects of high salinity on plant growth , such as toxicity which produces lesions in the cellular membranes (3 , 5, 6 ,7, 8 and 9) . Many evidence have been found to support this suggestion , rupturing of the outer chloroplasts membranes of corn (*Zea mays* L .) (6) , leakage of proteins from carrot (*Daucus carota* L .) roots (9) , leakage of solutes from soy bean (Glycin max L.) cotyledonary leaves (5) . General leakage of solutes from the cell indicates the damage of cell membrane (15) .The purpose of the present

study is investigation the morphological and physiological effects of saline irrigation water (drainage and ground water) as , compared with fresh water (river water in order to clear the relationship between salinity induced lesions and the effect of salinity on stability of ccll membrane , as view to reach water treatments techniques .

Materials and Methods

1. Experiment conditions

A. Chamber experiment

Seed of corn (which obtained from Ministry of Science and Technology , Iraq) were sterilized (4 , 13) and germinated in growth chamber (25 C^{O}) in Petri dishes contain moistened filter paper by treatment solution which were T_1 : Distilled water , T_2 : River water , T_3 : Drainage water T_4 : Ground water , for 2 days in darkness and 5 days under continues light of (2000 – 3000 Lux .)

B. Pots experiment .

After 7 days , the seedlings were pricked in black polyethylene pots contain 5 kg . of soil . Soil and irrigation water were described in table 1. Pots were placed in the green house and irrigated with the 4 types of water treatments and watered when it considered necessary with same mounts of above water quality .

2. Measurements .

a. Germination and growth .

Percentage and speed of germination were measured after 7 days , length and dry weight of shoots were measured after 4 weeks from pricking off . Dry weight was determined at 75C^{O} for 3 days , leaf area was measured using leaf area meter (Am . 3000) .

b. Ions determination .

Na^{+} and K^{+} concentrations in shoots and roots were determined spectroptometerically (15) after 4 weeks .

3. Stability of cell membrane .

This parameter was studied by measuring percent of relative injury (R.I) of roots by electrolyte determination of leaked roots after and before rupturing in autoclave then Electric conductivity (E.C) was measured by conductivity meter (11) and determination of leaf solutes leakage by using U.V Spectrophotometer (12) after 4 weeks from pricking .

4. Statistical analysis .

All data are average of 4 replicates and 2 similar experiments performed . Data were analyzed statistically using Completely Randomized Design (CRD) to calculate LSD at 0.05 and 0.01 between treatment means .

Results and Discussion

1: germination .

Treatments had an affect on the percentage and velocity of germination and shown in table 2 . Saline water (T_3 and T_4) reduced germination percentage by 28 and 31 % respectively , and speed of germination by 40 % and 42 % , respectively , in comparison with control (T_1) . That reduction may related to osmotic effect or / and unavailability of water which is very necessary for embryo development (3) . This is surely reflected their effect on a reduction in growth (shoot length , dry weight and leaf area) as shown in table 3.

2: Ions concentration .

Reduction in plant growth , could arise by the adverse effect of Na^+ on metabolism or by the adverse effect of water relations (14) . Table 4. shows the effect of treatments on Na^+ and K^+ concentrations in plant shoots and roots , due to the disturbance in Na^+ and K^+ concentration distribution .There was accumulation of Na^+ in shoot and root at T_3 and T_4 as compare with control treatment . On the other hand , it was found that , K^+ concentration decreases in plant shoot and root at T_3 and T_4 as compared with control and that decrease also had an adverse effects on plant growth , because of the physiological roles of K^+. The disturbance of Na^+ and K^+ concentrations of plant shoots and root s may arise the possibility of plasma membrane damage which has an important role to control the ionic and water content of plant cells , this suggestion was tested by the study of the stability in cell membrane (leaves leakage and relative injury percentages of root) .

3: Stability of cell membrane .

It can be seen from the data in table 5. that , there is a high percentage of solutes leakage from corn leaves at T_3 and T_4 , It is reached to 90 and 92.8 % , respectively , as compared with control treatment , which is reached to 43.3 % . Also , there is a high leakage of electrolytes of roots at T_3 and T_4 , (88.9 and 89.8 %) respectively , as compared with control treatment , which is reach to 45.9 % .

This indicates the high percentage of root injury , due to the high level of salinity of saline irrigation water (drainage T_3 and ground water T_4) .Salt induced solutes (electrolytes) or some time K^+ leakage from various plant tissue has been reported by many investigators (3 , 5 and 9) .This was related to the damage in the plasma membrane due to the interaction of ions with the biological macromolecules associated with the plasma membrane .This suggestion was interpreted by assuming that Na^+ weakens the membrane structure by displacing one or more of the divalent bridge provided by Ca^{+2} or other divalent cation (5) .Based on these indications , Ca^{+2} could be participate as a chemical amendment to solve the problem by using it in significant method with saline irrigation water as new technique to utilize the tremendous quantity of saline water whether drainage water or ground water .

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Table 1 : Chemical and physical characteristics of soil and water used in the (2) experiments .

Character	Soil	D.W	R.W	Dr .W	Gr.W
EC dS/m	4.10	0.00	1.10	8.50	9.60
pH	7.81	7.00	8.11	7.56	7.77
SAR	5.87	0.0	2.68	16.70	16.83
Soluble ions meq / L					
Na^{+}	20	0.0	3.8	54 .4	57.2
Ca^{+2}	7.9	0.0	1.4	8.8	9.0
Mg^{+2}	15.3	0.0	2.6	12.5	14.1
K^{+}	0.66	0.0	5.0	0.55	0.65
soil texture (%)					
Sand	02.5				
Silt	63.5				
clay	34.0				

D.W = distilled water
R.W = river water
Dr.W = drainage water
Gr.W = ground water .

Table 2 : Effect of treatments on percentage and speed of germination of corn plant .

Treatments	EC (dS/m)	Germination	
		(%)	Velocity seed / day
T_1 (D.W)	0.00	97.5	5.20
T_2 (R.W)	1.10	98.4	5.10
T_3 (Dr.W)	8.52	70.1	3.11
T_4 (Gr. W)	9.67	67.2	2.99
L.S.D 0.05		7.9	0.75
0.01		9.8	N.S

Table 3 : Effect of treatments on Length , dry weight and leaf area of corn plant .

Treatments	EC (dS/m)	Length (cm)	Dry weight (g)	Leaf area (cm^2)
T_1 (D.W)	0.00	40.7	2.3	140.1
T_2 (R.W)	1.10	45.9	2.7	147.9
T_3 (Dr.W)	8.52	20	0.6	31.8
T_4 (Gr. W)	9.67	18.2	0.4	30.1
L.S.D 0.05		10.4	0.67	15.7
0.01		13.0	0.95	19.4

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Table 4 : Effect of treatments in Shoot and Root contents of Na^+ and K^+

Treatments	EC dS/m	Shoot		Root	
		Na^+	K^+	Na^+	K^+
T_1 (D.W)	0.00	2.9	21.1	3.7	7.4
T_2 (R.W)	1.10	3.1	25.0	3.9	8.8
T_3 (Dr.W)	8.52	10.9	15.2	12.2	5.9
T_4 (Gr. W)	9.67	11.8	14.1	12.8	4.8
L.S.D 0.05		4.3	9.1	10.2	4.0
0.01		5.2	10.3	13.3	4.9

Table 5: Effect of treatments on Stability of cell membrane of corn plant .

Treatments	EC (dS/m)	Stability of cell membrane	
		Leaf leakage (%)	Relative injure (%)
T_1 (D.W)	0.00	43.3	45.9
T_2 (R.W)	1.10	49.8	50.5
T_3 (Dr.W)	8.52	90.1	88.9
T_4 (Gr. W)	9.67	92.8	89.8
L.S.D 0.05		11.5	12.1
0.01		12.3	13.3

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تأثير الري بمياه مختلفة الملوحة في إنبات ونمو و ثباتية الغشاء البلازمي لنبات الذرة الصفراء

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الخلاصة

درس تأثير أربعة أنواع مختلفة من ملوحة مياه الري في بعض الصفات المظهرية والوظيفية لنبات الذرة الصفراء صنف ربيع . وجد حصول اختزال في نسبة و سرعة الإنبات و نمو النباتات عند معاملتي المياه المالحة (البزل و الجوفية) ، ازداد محتوى النباتات من ايونات الصوديوم مقابل انخفاض محتواها من ايونات البوتاسيوم بزيادة تركيز الصوديوم في المياه المالحة . أدى الري بالمياه المالحة (البزل و الجوفية) إلى حصول تسرب عال للمواد الذائبة من خلايا الأوراق مع حصول ضرر نسبي كبير في خلايا الجذور للنباتات النامية في الوسط الملحي مقارنة مع النباتات النامية في الوسط غير الملحي . أشارت النتائج إلى إن تحطم الغشاء الخلوي لخلايا الجذور يعود إلى ارتفاع مستوى الملوحة فازداد محتوى النباتات من ايون الصوديوم مقابل انخفاض محتواها من ايون البوتاسيوم .

الكلمات المفتاحية : الملوحة ، الذرة الصفراء ، الغشاء البلازمي