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Effect of Irrigation Water Quality on Germination Growth and Mineral Content of Barley Grown on a Sandy Soil

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THE CURRENT study aims at investigating the effect of irrigation with saline waters having different ratios of Na : Ca : Mg with different SAR values and Cl : SO_4 with rather similar total salinity EC ≈ 12 or 13 dS m^{-1} on the germination, growth and chemical composition of barley plants.

A pot experiment was carried out under greenhouse conditions using a non-saline sandy loam soil collected from Abu-Zabal, Kalubia Gavernorate to study the effect of irrigation water quality on barley growth and its mineral contents.

Earthenware pots of (3 kg capacity) were used. Irrigated with saline solutions was done to field capacity. Soil moisture was maintained dailly over 60 % of its capacity by adding distilled water so as to keep soil available water. After complete germination, plants were thinned to 5 seedlings per pot and the germination percentage and germination rate were calculated. The experiment continued for 70 days, after that, the plants were harvested and separated to shoots and roots. Both length and dry weight of each part were recorded and the mineral content of plant shoots was determined. The obtained results could be sammarized as follows:

1. Increasing the SAR value decreased the germination percentage but increased the germination rate.
2. Increasing the SO_4^{-2} instead of the Cl^- increased germination percentage but had no effect on germination rate.
3. Increasing Mg^{2+} concentration gradually instead of Ca^{2+} or Na^+ showed a stimulation effect on seed germination of barley.
4. There were no significant difference among the different pairs of specific ions either on plant growth or chemical composition of plant shoots.

One of the inhibitory causes of salinity on plant growth is due to excessive absorbtion of a particular ion from the saline solution which leads to toxic accumulation of that ion along with a decrease in absorption of some essential nutrients. Regarding the ion and intensity of the electrical charge of ions, Hayward (1956) mentioned that monovalent cations depressed the cellular colloids and disorganized the function of the protoplasm, while the bivalent ones may coagulate and reduce the permeaility of the cell membranes. Strogonove (1962) reported that cations, in general, have coagulating properties that decrease permeability of the protoplasm; while anions have a peptidising effect on plasma colloids and thus increase its permeability.

Plant species vary greatly in the amount of sodium that they may accumulate. Many species tend to accumulate sodium while others tend to exclude it from leaves to the stem or roots. Helal *et al.* (1975) studied the effect of NaCl salinization on the growth of 4 - week - old barley plants grown in nutrient solution, and found that high concentration of NaCl reduced roots and shoots growth. They suggested that the negative influence of Na stress on plant growth is not primarily due to an impired protein synthesis, but to a determental effect on metabolic processes. Alberico and Cramer (1993) in a water culture found that presence of 80 mmol of NaCl / L in the nutrient solution caused a considerable increase in the concentrations of Na in the shoots and roots of maize plants. El-Kobbia and Omar (1972) found that increasing Na : Ca ratio of the culture media up to 30 : 10, in the form of Cl, was associated by an increase in Na-uptake. Further increase beyand that ratio over that limit (30:10) was followed by a decrease in Na - uptake.

Calcium ion may be toxic when it accumulates in high concentration in saline solutions, but its toxicity varies with plant species. Hayward (1956) attributed calcium deleterious effects to its coagulating effect on the plasma-colloids which results in a reduction in permeability of the cell membrane. Hall (1977) studied the effects of Ca concentration (up to 30 $mmol_c$ / L) on the growth of tomato plants grown in nutrient solutions, and found that the least amount of dry matter resulted from plants grown at the lowest level of Ca which suffered from Ca deficiency; dry matter was optimal from plants grown in the solution contaninig only 0.2 me. Ca/L but decreased at higher levels of the substrate calcium.

Kharazian *et al.* (1991) studied the effect of increasing Na Cl from 0 to 44 mmol/L in the root invironment of snap been plants and found that root and shoot growth decreased as concentration of NaCl increased; when they added calcium (as $CaCl_2$ or $CaSO_4$ to all levels of NaCl such growth was boosted. Kumar (1983) Showed that increasing Ca concentrations in solution culture up to 500 $mmol_c$ / L increased the rate of Mg absorption by the intact rice plants; and above such level, Ca and Mg absorption decreased. Muhammad (1983) suggested an antagonistic relation between Ca and Mg as to favour increased Ca/Mg ratio upon increased addition of Ca and *vice versa*, upon increased addition of Mg.

Magnesium salts could be of severe toxic effects on plants (Gauch & Eaton, 1942; El-Gabaly & Ghandi, 1958 and Gauch & Eaton, 1942) grew beans in isoosmotic concentrations of some salts and found that growth with Na_2SO_4, NaCl and $CaCl_2$ salts was rather similar and much greater than growth with $MgCl_2$ or $MgSO_4$; indicating a specific toxicity of Mg. El - Gabaly (1955) found that high Mg^{2+} concentration has more depressing effect on the growth of barley than high Ca^{2+} concentration.; and that Mg^{2+} inhibited the germination of barley seeds completely. Ehret *et al.* (1990) reported that wheat plants showed a higher incidence of foliar Ca defficiency symptoms than barley ones when grown under salinity stress created by $MgSO_4$ or (Na_2SO_4 plus $MgSO_4$) salts.

The toxic effect of chloride has been noticed by many investigators, but there is a tendency to regard its toxicity as a synonymous with the adverse effect of high salinity of the substrate. Eaton (1942) showed that the toxicity of chloride per unit of salt added was greater in the range from 4 to 20 than from 20 to 100 $mmol_c$/L, with a tendency of growth curve to be flat with increasing concentration of salts. El-Laboudi *et al.* (1973) studied phosphate nutrition of barley as affected by presence of 0.25 - 8.0 $mmol_c$ / L of Cl in the form of Na, K, Ca or Mg in growth medium of roots. They found that p-uptake was highest with $CaCl_2$ and lowest with with NaCl following a trend CaCl2 > $MgCl_2$ > KCl_2 > NaCl. They attributed the favorable effect of divalent cations to: (1) an increase in the turn - over rates for the phosphate carier complexes. (2) a synergistic role of Ca on P uptake. (3) on permeability of the outer cytoplasmic membrane of the plant roots. (4) varitions in the more screening of electronegative charges near the sites of absorption for diavalent sites accessible to the anions. Diab (1982) found that increasing NaCl concentration, up to 5.0 $mmol_c$ L^{-1} , in the nutrient solution increased Cl-uptake in roots and shoots of barley plants, but further increase up to 50 $mmol_c$ L^{-1} gave an opposite response due to the advers effect of salt treatment on plant.

Investigation on number of plants have indicated that high concentrations of sulfate may be toxic and limit the activity of calcium ion and thereby affect the cationic uptake of plants (Kumar *et al.*, 1987).

Material and Methods

The aim of the present study was to investigate the effect of irrigation with saline waters having different ratios of Na : Ca : Mg and Cl : SO_4 with rather similar 2 levels of total salinity, *i.e.*, EC $\approx$ 12 or 13 dS m^{-1} on the germination, growth and chemical composition of barley plants.

A pot experiment was carried out under greenhouse conditions using a non-saline sandy loam soil collected from Abu-Zabal, Kalubia Gavernorate. Table 1 shows some physical and chemical properties of the used soil which were determined according to the standerad methods outlined by Jackson (1973) and Piper (1950).

TABLE 1. Chemical and physical properties of the soil.

Soil properties	
EC, of saturation extract (dS m^{-1})	0.8
pH, of saturation extracts	7.7
$CaCO_3$ %	0.6
Organic matter %	0.1
Soluble cations (in saturation extract, $mmol_c$ / L)	
Na^+	2.3
K^+	0.2
Ca^{2+}	3.4
Mg^{2+}	2.1
Soluble anions (in saturation extract, $mmol_c$ / L)	
Cl^-	3.2
HCO^-	2.2
CO_3^{2-}	0.0
SO_4^{2-} *	2.7
Some Physical Properties	
F.C %	30.0
W.P %	8.0
Av.W %	22.0
Coarse sand %	40.4
Fine sand %	37.2
Silt %	7.8
Clay %	14.8
Soil texture	Sandy loam

* by subtraction

Earthenware pots were packed with the tested soil at the rate of 3 kg. Each pot was planted with twenty grains of barley (Hordeium vulgare cv G 123) were sown in each pot, thenafter irrigated to reach water holding capacity using 540 ml saline solutions per pot. The salinity and composition of the 5 different saline solutions are listed in Table 2 and 3. Soil moisture content was maintained dailly with distilled water to keep 60 % of its capacity. Each treatment was replicated three times. After complete germination plants were thinned to 5 seedlings per pot and the germination percentage and germination rate were calculated.

Germination rate was expressed as the mean number of days (M days) required for germination according to the formula of Edmond and Drapala (1958).

$$\text{M days} = \frac{(N_1 \times G_1 + (N_2 \times G_2) + \dots\dots\dots (N_n \times G_n)}{G_1 + G_2 \dots\dots\dots\dots\dots + G_n}$$

where:

N_1 = Number of days passed from sowing till the first count.
N_2 = Number of days passed from sowing till the second count.
N_3 = Number of days passed from sowing to N_n count.

Thenafter, 100 ml aliquot of Hogland solution and micronutrient solution was added once a week to each pot. The experiment continued for 70 days, after which, the plants were harvested and separated to shoots and roots, the length of each part was recorded. The plant material was dried at 70° and dry weights were recorded.

TABLE 2. Composition of the first series of salt solutions used in the expert.

Solution	EC dS m^{-1}	TDS mmol$_c$ L^{-1}	SAR	Na^+	Ca^{2+}	Mg^{2+} mmol$_c$ L^{-1}	Cl^{-1}	SO_4^{2-}
1	9.0	100	21	75.0	25.0	0	90.0	10.0
2	10.5	100	34	86.7	13.3	0	90.0	10.0
3	10.5	100	34	86.7	13.3	0	66.7	33.3
4	9.0	100	21	75.0	5.0	20	90.0	10.0
5	9.0	100	12	55.0	5.0	40	90.0	10.0

TABLE 3. Composition of the second series of salt solutions used in the expert.

Solution	EC dS m^{-1}	TDS mmol$_c$ L^{-1}	SAR	Na^+	Ca^{2+}	Mg^{2+} mmol$_c$ L^{-1}	Cl^{-1}	SO_4^{2-}
1	12	150	26	113	37.5	0	135	15
2	13	150	41	130	20	0	135	15
3	13	150	41	130	20	0	100	50
4	12	150	26	113	7.5	30	135	15
5	12	150	14	83	7.5	60	135	15

Plant analysis

Samples of dry matter of shoots were digested using a mixture of concentrated sulphuric and perchloric acids (3:1) and the digest was analysed for: Total nitrogen, phosphorus, sodium and potassium, calcium and magnesium according to the methods outlined by Jackson (1973).

The collected data were subjected to the statistical analysis according to Gomez and Gomez (1983) .

Results and Discussion

Specific ion effect on seed germination

Table 4 and Fig. 1 and 2 show the effect of specific ion on seed germination of barley plants at total salinity concentration of 100 and 150 me L^{-1}.

Effect of sodicity on seed germination

The overall trend of results relating the 100 mmol$_c$ L^{-1} treatments to the 150 mmol$_c$ L^{-1} treatments shows that increased salinity was associated with decreased germination percentage and increased germination rate (Table 4 and Fig. 1 and 2).

Comparing Soln. 1 to Soln. 2, results show that under conditions of 100 $mmol_c$ L^{-1} salinity level, increasing the SAR freom 21 to 34 (by increasing Na concentration from 75.0 to 86.7 on the expence of Ca) was associated with a slight decrease in germination percentage and a marked increase in germination rate. A similary comparison under conditions of 150 $mmol_c$ L^{-1} salinity level shows significant increase in germination rate upon increasing the SAR from 26 to 41 (by increasing Na on the expense of Ca).

TABLE 4. Specific ion effect on germination of barley plant seeds at various total salinity concentrations.

Solution No.	Ions concentration me L^{-1}					SAR	Total salinity concentration			
							100 me L^{-1}		150 me L^{-1}	
	Na^+	Ca^{2+}	Mg^{2+}	Cl^{-1}	SO_4^{2-}		Gremination		Germination	
							%	Rate	%	Rate
1	75.0	25.0	0.0	90.0	10.0	21.0	83	6.81	77	7.5
2	86.7	13.3	0.0	90.0	10.0	34.0	82	7.11	72	7.9
3	86.7	13.3	0.0	66.7	33.3	34.0	85	7.01	73	7.5
4	75.0	5.0	20.0	90.0	10.0	21.0	83	6.82	77	7.5
5	55	5.0	40.0	90.0	10.0	12.0	85	6.72	83	7.0

L.S.D. for

Germination at total salinity concentration 100 me L^{-1}

0.05 = 3.8 Rate: 0.05 = 0.24

0.01 = 5.1 0.01 = 0.32

Germination at total salinity concentration 150 me L^{-1}

0.05 = 4.8 Rate: 0.05 = 0.23

0.01 = 6.4 0.01 = 0.31

Therefore increasing both salinity and / or SAR resulted in a decrease in the germination percentage and an increase in the germination rate. These results agree with those obtained by Abd El - Rahman *et al.* (1979) and Kumar *et al.* (1980) who found adverse effects of salinity on seed germination of barley.

The reduction in germination percentage with increasing the SAR values of salt solutions can be attributed to a specific toxic effect of NaCl as well as to an increase in the osmotic pressure of the salt solution (Bernstien & Pearson, 1956 and Strogonov, 1962). The specific toxic effect of Na Cl on germination of plant seeds is related to an adverse effect of Na Cl on the enzymatic processes caused by its interaction with some organic substances of the cell (Oertil, 1966). The adverse effect of monovalent cations such as Na^+ on the cell protoplasm is related to dispersion of colloids of the protoplasm (Grillot, 1956).

Effect of sulphate ion on seed germination

Comparing Soln. 2 to Soln. 3 results in Table 4 and Fig. 1 and 2 elucidates the effect of the increase in the concentration of $SO_4^{=}$. Data show that the increase from a concentration of 10 to a concentration of 33 $mmol_c$ / L on the expence of Cl caused an increase in germination percentage and a decrease in germination rate for plants treated with the 100 as well as 150 $mmol_c$ / L solutions. Therefore increasing $SO_4^{=}$ on the expense of Cl^- alleviated the adverse effect on germination caused by the Cl^- ions .

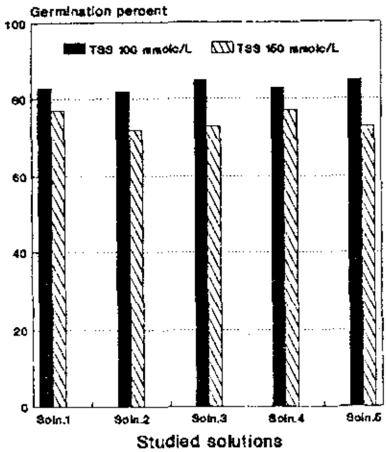

Fig.1. Specific ion effect on germination Percent of barley seeds.

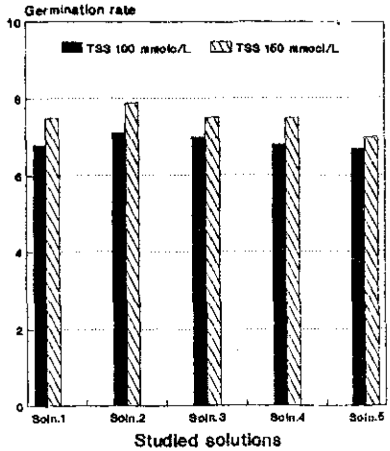

Fig.2. Specific ion effect on germination rate of barley seeds.

Effect of magnesium ion on seed germination

Comparing Soln. 4 and Soln. 5 results in Table 4 and Fig. 1 and 2 elucidates the effect of the increase in the concentration of Mg ions. Data show that the increase in Mg on the expense of Ca increased germination percentage and decreased germination rate. Such a promotive effect on germination caused by increased magnesium was particularly evident with the 150 $mmol_c$ / L solution. The increase of Mg^{2+} was at the expense of Na^+ with the improvement which occurred in germination reflects the necessity of a suitable ratio of Mg and Na, along with Ca ions for enhanced germination. Work reported by El-Gabaly (1955) and Grillot (1956) showed that solutions of magnesium ions in absence of Na and Ca were of toxic effect to germination of seeds of barley plants.

In conclusion, it may be stated that Mg ion had a stimulation effect on seed germination of barley plants. This effect may be attributed to that the mixtures of salts (Na^+, Ca^{2+} and Mg^{2+}) in (Soln. 1 and Soln. 2) were less toxic than the pure solution of Mg^{2+}. Supplying the growing plant with an essential element and entire absence of the other ones aggravate the deficiency hazard of the later.

Specific ion effect on plant growth

Table 5 and Fig. 3 and 4 show the effect of specific ion on dry weight and height of barley plants as follows:

Shoots length

Results reveal that increasing Na^+ concentration (from 75 to 86.7 me L^{-1}) in irrigation water, on the expense of Ca^{2+} tended to reduce (insignificantly) shoots length of barley plants, while increasing both Mg $^{2+}$ ion concentration (from 20 to 40mmol $_cL^{-1}$) on the expense of Na^+ ion and SO_4^{2-} ion concentration (from 10 to 33.3 mmol $_cL^{-1}$) on the expense of Cl- (also insignificantly induced the plant shoots length.

TABLE 5. Specific ions effect on some growth parameters of barley plants.

Solution No.	SAR	Ions concentration (me L^{-1})					Plant length (cm)		dry weight (g/pot)	
		Na^+	Ca^{2+}	Mg^{2+}	Cl^-	SO_4^{2-}	Shoots	Roots	Shoots	Roots
1	21.0	75.0	25.0	00.0	90.0	10.0	52.32	27.71	52.32	27.71
2	34.0	86.7	13.3	00.0	90.0	10.0	51.71	26.71	51.71	26.71
3	34.0	86.7	13.3	00.0	66.7	33.3	52.02	27.02	52.02	27.02
4	21.0	75.0	5.0	20.0	90.0	10.0	53.33	28.02	53.33	28.02
5	12.0	55.0	5.0	40.0	90.0	10.0	54.33	28.73	54.33	28.73

L.S.D for:

Shoots dry weight,	0.0 5 = 0.36	0.01 = 0.48
Roots dry weight,	0.05 = 0.10	0.01 = 0.14
Shoots length,	0.05 = 2.63	0.01 = 3.71
Roots length,	0.05 = 1.86	0.01 = 2.25

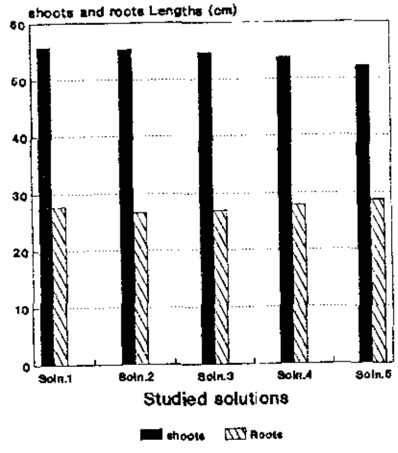

Fig. 3. Specific ion effect on shoots and roots length (cm) of barley plants .

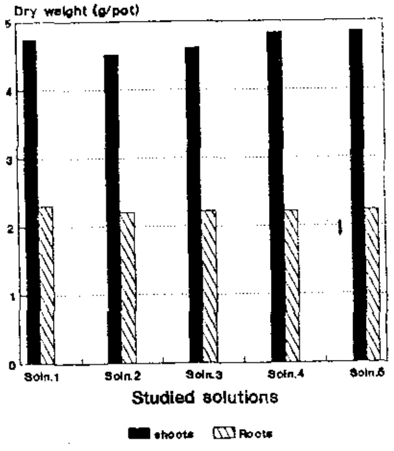

Fig. 4. Specific ion effect on shoots and roots dry weight of barley plants .

Roots length

Concerning the specific ion effects on roots length of barley plants, data show the increasing the SAR value (from 21 to 34) by increasing Na^+ concentration (from 75 to 86.7me L^{-1}) in irrigation water, on the ecpense of Ca^{2+} significantly inhibited the root length of barley plants.

On the other hand, it is obvious that increasing the SAR of irrigation water (from 21 to 34) by increasing Na^+ concentration on the expense of Mg yielded different insignificant effect which may suggest that Ca is more effective than Mg as a factor for minimizing the hazardous effect of Na on plant roots length.

The highest rate of SAR reduction (from 34 to 12) led to the highest length of barley plant roots.

Dry weight

Comparing Soln. 1 and Soln. 2 results, in Table 5 and Fig 4 elucidate the effect of the increase in the concentration of Na ions. Data show that the increase in Na ions on the expense of Ca ions at total salinity concnetration of 100 me L^{-1}, *i.e*, increasing the SAR value of salt solution from 21 to 34 reduced the dry weight of barley plant shoots and roots from 4.74 to 4.52, (g/pot) and from 2.23 to 2.21 (g/pot) respectively. Results indicate no significant differences among the solutions pairs due to specific ion effect neither on the shoots nor on the roots dry weight of barley plant.

From the previous results, it can be concluded that the different ions have significant specific effects on the growth of barley plants. The chloride injury is attributed to its dipressing effect on the availability of nutritional elements particularly phosphorous and sulfate (Grillot, 1956; Hayward, 1956 and Corbett & Gausman, 1960).

Specific ion effect in relation to the chemical composition of barley plants

Table 6 shows the specific ion effect in relation to the chemical composition of barley plant shoots (*i.e.*, N, P, K, Na, Ca and Mg - content g/100 g). Results indicate that there is no significant effect among the solutions of the specific ion on N, P, K, Na, Ca and Mg - content within tissues of barley plant shoots.

TABLE 6. Specific ions effect on N, P, K, Na, Ca and Mg contents of barley plant shoots (g/100 g).

Solution No	SAR	Ions concentration (me L^{-1})					Mineral content of barley shoots (g / 100 g)					
		Na^+	Ca^{2+}	Mg^{2+}	Cl^-	SO_4^{2-}	N	P	K	Na	Ca	Mg
1	21.0	75.0	25.0	00.0	90.0	10.0	1.91	0.89	2.23	1.11	2.50	0.37
2	34.0	86.7	13.3	00.0	90.0	10.0	1.84	0.85	2.15	1.14	1.95	0.4
3	34.0	86.7	13.3	00.0	66.7	33.3	1.83	0.87	2.17	1.08	2.00	0.43
4	21.0	75.0	5.0	20.0	90.0	10.0	1.90	0.88	2.21	1.07	1.94	0.47
5	12.0	55.0	5.0	40.0	90.0	10.0	2.00	0.89	2.21	0.99	1.89	0.47

L.S.D. for	N	P	K	Na	Ca	Mg
0.05	0.80	0.11	0.05	0.07	0.44	0.12
0.01	1.1	0.15	0.06	0.09	0.60	0.16

References

Abd El Rhaman, A.A.; Khalifa, M.A.; Gomaa, A.A. and Hassanien, H.G. (1979) Tolerance of barley, wheat, and triticale to salinity. *Assuit J. Agric. Sci.* **10** (1), 56

Alberico, G.J. and Cremer, G.R. (1993) Is the salt tolerance of maize related to sodium exclusion. I-Preliminaryscreening of seven cultivars. *J. Plant Nutr.* **16**, 2289.

Bernstein, L. (1962) Salt affected soil and Plants. Arid Zone Research. YVIII. The Problem of the arid zones. UNESCO, *Pario* , 139 .

Bernstein and pearson, G.A. (1956) Influence of exchangeable and sodium percentage on the yield and Chemical Composition of plants. 1-Green beans, garden beets, colver and alfalfa. *Soil Sci.* **82,** 247.

Corbett, E.G. and Gausman, H.W. (1960) The interaction of chloride with sulfate and phosphate in the nutrition of potato plants (*Solanum tubersum*). *Agron. J.* **52**, 94.

Diab, M.D. (1982) Effect o f salinity o n n utrients u ptake b y p lant. *Ph. D. Thesis*, F ac. Agric., Al-Azhar Univ., Egypt.

Eaton, F.M. (1942) Toxicity and accumulation of chloride and sulfate salts in plants. *J. Agric. Res.* **64**, 357 (*c.f.* Hayward, H.E. and Waldeigh, G.H., 1949) .

Eaton, F.M.; Olmstead, W.R. and Toyler, O.C. (1971) Salt injury to plants with special reference to cations versus anions and ion activities. *Plant and Soil* **35**, 433.

Edmond, J.B. and Drapala (1958) The effect of temperature, sand and soil and acetone on germination of Akrea seeds. *Proc. Am. Soc. Hort. Sci.* **71**, 428.

Ehret , D.L; Real mann, R.E.; Harvey, B.L. and Cigywnyk, A. (1990) Salinity induced calcium deficiencies in wheat and barley. *Plant and Soil* **128** , 143.

El-Gabaly, M.M. (1955) Specific effects of absorbed ions on plant growth. *Soil Sci.* **80**, 235.

El-Gabaly, M.M. and Ghani, A.M.A. (1958) Specific effects of adsorbed ions on plant growth. *J. Soil Sci.* **38**, 103.

El- Laboudi , A.E.; El–Kobbia, T. and Moukhtar, M.M. (1973) Comparative study of the effect of cations associated with different anions on the phosphate nutrition of plants . *Egypt. J. Soil Sci* **16** , 97.

El- Kobbia, T. and Omar, M.A. (1972) Anions uptake as influenced by exchangeable sodium. *Egypt . J. Soil Sci* . **12** , 159.

Gauch, H.G. and Eaton, F.M. (1942) Effect of saline substrate on hourly levels of carbohydrates and inorganic constituents of barley plants. *Plant Physiol.* **17**, 347.

Gomez, A.K. and Gomez, A.A. (1983) "*Statistical Procedures for Agricultural Research*", 2nd ed., P. 680, Jhon wiely and Sons, New York.

Grillot, G. (1956) The biological and agricultural problems presented by plants tolerant of saline or brakish water and the employment of such water for irrigation. *Review of research on problems of utilization of saline water.* UNESCO, Paris, 9-37.

Hall, D.A. (1977) Some effects of varied calcium nutrition on the growth and composition of tomato plants . *Plant and Soil* **48** , 199 .

Hayward, H.E. (1956) Plant growth under saline conditions. *"Review of Research on Problems of Utilization of Saline Water"*, pp. 37-71, UNESCO, Paris.

Helal, M.; Koch, K. and Mengel, K. (1975) Effect of salinity and potassium on the uptake of nitrogen and on nitrogen metabolism in young barley plants . *Physiol . Plant.* **35**, 310 .

Jackson, M.L. (1973) *"Soil Chemical Analysis"*, Prentic Hall, India Private, LTD, New Delhi.

Kharzian, W.F.C.; Jurimak, J.J. and Dudley, L.M. (1991) Calcium amelioration of sodium chloride effects on plant growth, chlorophyll, and ion concentration in *Phaseolus vulgarir. Arid Soil Res. and Rehabilitation* **5**, 9.

Kumar, D.; Singh, C.P. and Sharma, N. N. (1980) Comparative studies of a grain yield and nutrition in barley as affected by the application of saline water for irrigation. Sabrao J. 15, 71. (*c.f. Wheat, Barley, and Tritical. Abst.* **1** (2), 782, 1982) .

Kumar, N.F. (1983) Ionic interactions in rice plants from dilute solutions . *Plant and Soil* **70** , 309 .

Kumar, V.D.; Kumar and Chaudan, C. R. S. (1987) Effect of saline water with varying $Cl:SO_4$ ratio and phosphorus levels on the growth and yield of bread wheat and soil properties.*Indian J. Agric. Sci.* **57**, 668.

Muhammad, H.S. (1983) Studies on the ion balance as related to absorption of some nutrients by plants. *M. Sc. Thesis*, Fac. Agric., Ain Shams Univ., Egypt.

Oertil, J.J. (1966) Effect of external salt concentration on water relations in plants. *Soil. Sci.* **102** , 258.

Ordin, L. (1960) Effect of water stress on the cell wall metabolism of *Avena cleoptile tissues. Plant Physniol. Lancoster* **35** , 443.

Piper, C. S. (1950) *"Soil and Plant Analysis"*, Inter, Sci. Publ., Inc. New York.

Strogonov, B.P. (1962) Physiological basis of salt tolerance of plants (as affected by various types of salinity). Acad Sci. USSR. Inst. *Plant Physiol.* English translation by Israel program Translocation (1963) .

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تأثير نوعية مياه الرى على إنبات ونمو والتركيب الكيماوى لنبات الشعير النامى في أرض رملية

عصمت حسن عطية نوفل

قسم علوم الأراضى– كلية الزراعة – مشتهر – جامعة الزقازيق – فرع بنها – مصر.

أجري هذا البحث بهدف تقييم التأثير النوعى للأيون على نسبة ومعدل الإنبات وكذلك النمو والتركيب الكيميائى للمجموع الخضرى لنباتات الشعير صنف جيزة ١٢٣، وقد أوضحت الدراسة النتائج التالية :

١. أدت زيادة قيمة "SAR" إلى انخفاض نسبة الإنبات وزيادة فى معدل الإنبات ولكن التأثير كان أكثر وضوحا عند مستوى الملوحة الكلية (١٥٠ مليمكافىء / لتر) عن المستوى (١٠٠ مليمكافىء/لتر).

٢.أدت زيادة تركيز أيون الكبريتات على حساب أيون الكلوريد إلى زيادة نسبة الإنبات بنفس الدرجة تقريباً عند مستويات ملوحة كلية (١٠٠ ، ١٥٠ مليمكافىء/لتر) ولكن لم يكن لها تأثير معنوى على معدل الإنبات.

٣. كان لزيادة تركيز أيون المغنيسيوم على حساب أيون الصوديوم أو الكالسيوم (سواء عند ١٠٠ أو ١٥٠ مليمكافىء / لتر) تأثير مشجع لإنبات بذور نباتات الشعير .

٤. لم يكن هناك اختلافات معنوية واضحة بين أزواج المعاملات للتأثير النوعى للأيون سواء على النمو أو التركيب الكيميائى للنبات عند مستوى الملوحة الكلية (١٠٠ مليمكافىء / لتر) .