تأثير التسميد بالبوتاسيوم والتسميد الحيوى بالخميرة على تحمل نباتات الكركديه للرى بالماء المالح

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أجريت هذه التجربة خلال موسمين متتالين هما ١٩٩٩ ، ٢٠٠٠ بمحطة الأبحاث الزراعية بجامعة الملك عبد العزيز بهدى الشام – جدة المملكة العربية السعودية وذلك لدراسة تأثير استخدام خمس جرعات من البوتاسيوم (صفر، ١٨، ٣٦، ٥٤، ٧٢ كجم بوتاسيوم/للفدان) بدون أو مع ثلاثة تركيزات من الخميرة (صفر، ٠,٢%، ٠,٤%) على ارتفاع النبات، عدد الأفرع الجانبية والثمار للنبات، الوزن الطازج والجاف للأوراق والساق والجذور والسبلات والثمار ومحتوى النبات من الصبغات مثل الأنثوسيانين والفلافون لنباتات الكركديه والتى يتم ريها بماء الابار المالحة (التوصيل الكهربائى لها ٢,٤ ديسى سيمنز/متر) وقد تم التسميد الأرضى للبوتاسيوم والرش الورقى للخميرة ثلاثة مرات بعد الزراعة بـ ٤٥، ٩٠، ١٣٥ يوم.

أشارت نتائج الدراسة ان استخدام البوتاسيوم والخميرة كان فعالا جدا فى تحسين جميع الصفات الخضرية ومحتوى النبات من الصبغات مثل الأنثوسيانين والفلافون وذلك بالمقارنة بعدم استخدام هذه المعاملات والرى بماء الابار المالح وكان التحسين فى هذه الصفات مرتبطا بزيادة الجرعة المستخدمة من البوتاسيوم من صفر الى ٧٢ كج/فدان والتركيز المستخدم من الخميرة من صفر الى ٠,٤ % ولم تكن هناك زيادة كبيرة فى هذه الصفات بين أعلى جرعتين من البوتاسيوم وأعلى تركيزين من الخميرة.

يمكن القول بأن تسميد نباتات الكركديه النامية تحت الظروف الملحية بالبوتاسيوم ٥٤ بمعدل كجم/للفدان مع رش الخميرة تركيز ٠,٢% ثلاثة مرات يكون ضروريا لتقليل الاثار الغير مرغوبة لملوحة مياه الرى على صفات النمو والتركيب الكيماوى للنباتات.

properties of certain soil of Egypt. Egypt J. Soil Sci., 32: 391-406.
Mottial, V.S.; K.K. Basario; R.P. Singh and R.S. Singm (1979). Response of Gladiouls to NPK fertilization. Plant Sd., 11-69-79.
Nabih, A.(1991). Effect of some potting media and chemical fertilization on growth, flowering and corm productivity of Freesia refracta cv. Aurora. J. Agric. Tanta Univ., 17(3): 1991.
N.R.P. (1977). Nutrient requirements of domestic animals No.17th. Rev Ed. National Academy of Science, Washington, *D.C.* U.S.A.
Nijjar. G.S. (1985). Nutrition of Fruit Trees. Mrs, Usha Raj. Kumar for Kalyani Publishars, New Delhi, 10-270.
Page, A.L.; R.H. Miller and D.R. Kenney (1982). Methods of Soil Anaiysis Amer. Soc. of Agronom, Madison, Wisconsin, U.S.A.
Potti, S.K. and J.S. Arora (1986). Nutritiolial studies in Gladiolus cv. sylvia. I. Effect of N.P. and K on growth, flowering, corn and cormels production. India Agric., 26: 125-128.
Selim S.M.; A.M. Rokba; M.R. Hassan and M.A. Hassanain (1993). Effect of sowing dates, nitrogenous and potassium fertilization on roselle plant II Effect on chemical composition. Egypt. J. Hort., 20(1): 97-109.
Singh, R.V. and R.R. Singh (1990). Uptake of nitrogen. phosphorus and potassium by guar *(Cyamopsis tetragonoloba* L.) as influenced by nitrogen (with and without seed inoculation) phosphorus and seedling rates under rain fall conditions. Annals of Agricultural Research, 11(3-4): 329-332.
Snedecor, G.M. and W.C. Cochran (1973). Statistical Methods 6th E.d., Iowa State Univ., Press, Iowa, U.S.A.
Somida, E.G. (1998). Response of *Nigella sativa,* L. Plants grown in sandy soil to some nitrogen and potassium fertilization treatments. M.Sc. Thesis, Fac. Agric., Minia Univ.
Sutarno, H. (1984). The effect of salinity (NaCl) on the growth of *Amaranthus peniculatus.* L. Imu Partanion, 3 (7), 295. (Ornam. Hort.Abst., 13, 1185).
Wahab, A.S. and L. Hornok (1982). Effect of NPK fertilization on Ocimun basilicum yield and essential oil content. Kreszeti Gyptenm Kozlemenyei, 45 (13): 65-75.
Wange, S.S. (1996). Effect of bio-fertilizers under graded nitrogen levels on carrot *(Daucus carota* L.). Annals of Plant Physiology., 10(1): 96-98.
Zidan, M.A. and A.A. Malibari (1993). The role of K in alleviating stress affecting growth and some organic and mineral components of wheat. Arab Gulf J. Scient. Res., 11: 201-208.
Zile, S and A.K. Gupta (1996). Effect of nitrogen, phosphorus and potassium application on the mineral composition of Dahlia variabilis, Wild cv. Powder Puff. Environment and Ecology.

Ali, A.F. (2001). Response of pot marigold *(Calendula officinalis,* L.) plants to some rock phosphate sources and yeast. The 5th Arabian Hort. Conf. Ismailia, Egypt March 24-28, pp 31-41.

Al-Omran, A.M. (1987). Evaluation of some irrigation water in central region of south Arabia J. Coll. Agric. King Saud Univ., 9: 363-369.

Attia, F.A. and M.K. Aly (1994). Effect of NPK fertilization and planting density on flowering bulb production and chemical composition of Iris plants. Menofiya. J. Agric. Res., 19 (1).

Badran, F.S. (1988). Effect of soil type and NPK fertilization on growth and flowering of *Polianthes tuberosa* L. plants. Minia J. Agric. Res. & Dev., 11 (1).

Badran, F.S.; LA. Al-Badawy and M.K. Aly (1989). Effect of NPK fertilization treatments and spacing on the growth and flowering of *Zantedeschia aethiopica,* Minia. J. Agric. Res. & Dev., 11(3).

Balba, A.M..; S.Kh. Attia and Y.M. El-Fakhrani (1982). Potassium relationships with soil and plant under saline conditions Alex. Sci. Exch., 3: 45-58.

Beristein, L.; L.E. Francois and R.A. Clark (1974). Inactive effects of salinity and fertility on yields of grains and vegetables Agric. J., 66: 412-421.

De-Losser, R. (1970). Flower pigment composition of natural bud variants among hybrid chinese azaleas., Rhododeudron Simssi (Planch). J. Hort. Sci., 45: 265.

Dibb, D.W. (1998). Potassium for Agriculture. Adapted and reprinted from better crops with plant food. Issue No.3 Puplished by the Potash & Phosphate Institute.

El-Fakhrani, Y.M. (2001). Effect of K fertilization on the tolerance of potato plants irrigated with saline groundwater. The fifth Arabian Horticulture Conference, Ismailia, March 24-28 pp 141-151.

Fahmy, R. (1970). Different Quantitative Estimation of some organic compounds in plants. Anglo Egypt, Press, Cairo Egypt pp 10-20.

Farahat, M.M. (1990). Salinity and drought tolerance of *Schinus molt, S. terebintiijfolius* and *Myoporum acuminatum* Ph.D. Thesis is Fa., Agric. Cairo Univ.

Fathi, M.A. (1989). Effect of Salinity irrigation water on some apple rootstocks. Ph.D. Thesis, Fac. Agric., Cairo Univ., Egypt.

Feigin, A. (1985). Fertilization management. of crops irrigated with saline water. Plant and Soil, 89: 285-299.

Koriesh. E.M. and E.S. Badawy (1984). Effect of chemical fertiliization on growth, flowering, corm formation and yield in Freesia (Freesia refracta, jaco, klatt). The third Arab Hort. Conf., Egypt. Soc. Hort.

Koriesh, E.M.; M.A. Helmy and S. Kh. Attia (1983). The response of *Cyperus esculentus* L. to nitrogen. phosphorus and potassium fertilization. Annala of Agric. Sci. Moshtohor, 23 (4)

Maurcar, N.E. and A. Temoat (1990). Effects of rootzone solutes on *Cameldulensis* and *E. bicostata* seedlings, responsesis Na^+, Mg^{++} + and Cl^- Plant and Soil, 125 (2): 245.

Mostafa, M.A.; E.M. Khaled; A.M. El-Sweedy and A. S. H. Abd El-Nour (1992). The effect of irrigation water quality on some chemical

Table (7): Effect of various potassium levels and active dry yeast concentrations on dry weight of fruits/plant (g), Anothcyanine (mg/g sepal) and flavones (mg/g sepal) of *Hibiscus sabdariffa* L. plants during 1999 and 2000 seasons.

Character K levels and Concentration (A)	Active dry yeast concentrations (B)							
	1999				2000			
	0.0%	0.2%	0.4%	Mean	0.0%	0.2%	0.4%	Mean
Dry weight of fruits/plant (g)								
K at 0.0 kg/fed.	17.78	18.79	18.90	18.49	18.55	20.12	20.16	19.61
K at 18 kg/fed.	19.25	20.26	20.30	19.94	20.26	20.23	20.30	20.26
K at 36 kg/fed.	20.40	21.45	21.52	21.12	21.45	24.50	24.81	23.59
K at 54 kg/fed.	21.70	22.75	22.85	22.40	23.03	25.41	25.55	24.66
K at 72 kg/fed.	21.80	22.85	22.92	22.52	22.96	25.48	25.55	24.66
Mean (B)	20.19	21.22	21.30		21.25	23.17	23.27	
LSD at 5%	A	B	AB		A	B	AB	
	0.83	0.70	1.60		1.20	0.97	2.17	
Anothcyanine (mg/g sepal)								
K at 0.0 kg/fed.	0.29	0.33	0.34	0.53	0.28	0.31	0.32	0.31
K at 18 kg/fed.	0.35	0.39	0.30	0.38	0.31	0.34	0.35	0.34
K at 36 kg/fed.	0.39	0.44	0.45	0.43	0.35	0.38	0.39	0.38
K at 54 kg/fed.	0.44	0.48	0.49	0.47	0.39	0.43	0.44	0.42
K at 72 kg/fed.	0.45	0.49	0.50	0.63	0.40	0.44	0.45	0.43
Mean (B)	0.38	0.42	0.43		0.34	0.38	0.39	
LSD at 5%	A	B	AB		A	B	AB	
	0.04	0.03	0.07		0.03	0.02	0.04	
Flavones (mg/g sepal)								
K at 0.0 kg/fed.	0.28	0.31	0.32	0.31	0.27	0.29	0.30	0.29
K at 18 kg/fed.	0.33	0.37	0.38	0.36	0.29	0.32	0.33	0.32
K at 36 kg/fed.	0.37	0.41	0.42	0.40	0.33	0.36	0.37	0.36
K at 54 kg/fed.	0.41	0.45	0.47	0.45	0.37	0.40	0.41	0.39
K at 72 kg/fed.	0.42	0.47	0.47	0.46	0.38	0.41	0.42	0.40
Mean (B)	0.36	0.40	0.41		0.32	0.35	0.36	
LSD at 5%	A	B	AB		A	B	AB	
	0.04	0.03	0.07		0.04	0.03	0.07	

REFERENCES

Abdel-aal, A.H. and F.F. Ahmed (2001). The necessity of potassium for Flame seedless grapevines irrigated with saline water. The fifth Arabian Horticulture *Conference*, Ismailia March 24-28 pp 75-82.

Abdel aal, Sb. I; R.E. A. Sabrah; R.K. Rabie and H.M. Abdel-Mgid (1997). Evaluation of ground water quality for irrigation in central Saudi Arabia. Arab Conf. J. Scient. Res., 15: 361-377.

Ahmed, F.F.; A.M. Akl; F.M. El-Morsy and M.A. Ragab (1997). The beneficial effect of biofertilizers on Red Roomy grapevine *(vitis vinfera* L.). The effect on growth and vine nutritional status. Annals of Agric. Sd. Moshtohor., 35(1): 489-495.

Ahmed, Sb.K.; E.O. El-Ghawas and A.F. Aly (1998). Effect of active dry yeast and organic manure on Roselle plant. Egypt. J. Agric. Res., 76 (3).

Table (5): Effect of various potassium levels and active dry yeast concentrations on fresh weight of sepals/plant (g), fresh weight of fruits/plant and fresh weight of leaves of *Hibiscus sabdariffa* L. plants during 1999 and 2000 seasons.

Character K levels and Concentration (A)	Active dry yeast concentrations (B) 1999				2000			
	0.0%	0.2%	0.4%	Mean	0.0%	0.2%	0.4%	Mean
Fresh weight of sepals/plant								
K at 0.0 kg/fed.	20.3	21.5	21.6	21.1	21.2	22.9	23.0	22.4
K at 18 kg/fed.	22.0	23.0	23.1	22.7	22.9	24.0	24.2	23.7
K at 36 kg/fed.	23.3	24.5	24.6	24.1	24.3	27.9	28.0	26.7
K at 54 kg/fed.	24.8	25.9	26.0	25.6	26.2	28.9	29.0	28.0
K at 72 kg/fed.	24.9	26.0	26.2	25.7	26.3	29.0	29.1	28.1
Mean (B)	23.1	24.2	24.3		24.2	26.5	26.6	
LSD at 5%	A 1.3	B 1.0	AB 2.2		A 1.1	B 0.7	AB 1.6	
Fresh weight of fruits/plant (g)								
K at 0.0 kg/fed.	50.8	53.7	54.0	52.8	53.0	57.5	57.6	56.0
K at 18 kg/fed.	55.0	57.9	58.0	57.0	57.9	57.8	58.0	57.9
K at 36 kg/fed.	58.3	61.3	61.5	60.4	61.3	70.0	70.9	67.4
K at 54 kg/fed.	62.0	65.0	65.3	64.1	65.8	72.6	73.0	70.5
K at 72 kg/fed.	62.3	65.3	65.5	64.4	65.6	72.8	73.0	70.5
Mean (B)	57.6	60.6	60.8		60.7	66.1	66.5	
LSD at 5%	A 1.9	B 1.5	AB 3.4		A 1.8	B 1.8	AB 4.0	
Fresh weight of leaves/plant (g)								
K at 0.0 kg/fed.	5.99	6.29	6.38	6.22	5.12	6.38	6.44	6.31
K at 18 kg/fed.	7.02	8.21	8.33	7.85	7.19	7.87	7.99	7.68
K at 36 kg/fed.	7.96	8.67	8.76	8.46	7.80	8.30	8.33	8.14
K at 54 kg/fed.	8.38	9.45	9.52	9.12	8.21	9.50	9.57	9.09
K at 72 kg/fed.	8.50	9.49	9.52	9.17	8.33	9.52	9.61	9.15
Mean (B)	7.57	8.42	8.50		7.53	8.31	8.39	
LSD at 5%	A 0.25	B 0.22	AB 0.49		A 0.24	B 0.20	AB 0.50	

Table (6): Effect of various potassium levels and active dry yeast concentrations on dry weight of stem, roots and sepals/plant of *Hibiscus sabdariffa* L. plants during 1999 and 2000 seasons.

Character K levels and Concentration (A)	Active dry yeast concentrations (B) 1999				2000			
	0.0%	0.2%	0.4%	Mean	0.0%	0.2%	0.4%	Mean
Dry weight of stem/plant (g)								
K at 0.0 kg/fed.	19.11	19.59	19.64	19.45	18.90	19.59	19.74	19.41
K at 18 kg/fed.	20.01	20.69	20.79	20.50	19.74	20.37	20.48	20.20
K at 36 kg/fed.	20.64	21.42	21.46	21.17	20.79	21.63	21.76	21.39
K at 54 kg/fed.	21.42	22.11	22.24	21.92	21.69	22.37	22.47	22.18
K at 72 kg/fed.	21.48	22.16	22.26	21.97	21.71	22.47	22.58	22.25
Mean (B)	20.53	21.19	21.28		20.57	21.29	21.41	
LSD at 5%	A 0.60	B 0.46	AB 1.03		A 0.61	B 0.50	AB 1.10	
Dry weight of roots/plant (g)								
K at 0.0 kg/fed.	3.51	3.83	3.86	3.73	3.83	4.27	4.29	4.13
K at 18 kg/fed.	3.86	4.29	4.32	4.16	4.13	4.56	4.59	4.43
K at 36 kg/fed.	4.29	4.56	4.59	4.48	4.64	4.83	4.86	4.78
K at 54 kg/fed.	4.56	4.94	5.00	4.83	5.24	5.72	5.75	5.57
K at 72 kg/fed.	4.59	4.97	5.02	4.86	5.37	5.40	5.45	5.41
Mean (B)	4.16	4.52	4.56		4.64	4.96	4.99	
LSD at 5%	A 0.29	B 0.21	AB 0.47		A 0.27	B 0.19	AB 0.43	
Dry weight of sepals/plant (g)								
K at 0.0 kg/fed.	3.65	3.87	3.89	3.80	3.82	4.12	4.14	4.03
K at 18 kg/fed.	3.96	4.14	4.16	4.09	4.12	4.32	4.36	4.27
K at 36 kg/fed.	4.19	4.41	4.43	4.43	4.37	5.02	5.04	4.81
K at 54 kg/fed.	4.46	4.66	4.68	4.60	4.72	5.20	5.22	5.05
K at 72 kg/fed.	4.48	4.68	4.72	4.63	4.73	5.22	5.24	5.06
Mean (B)	4.15	4.35	4.38		4.35	4.78	4.80	
LSD at 5%	A 0.16	B 0.15	AB 0.34		A 0.19	B 0.17	AB 0.38	

concentrations of yeast, without considerable differences between using 0.2 and 0.2% yeast in both seasons.

Similar results were obtained by Ahmed *et al.* (1998)) on Roselle and Ali (2001) on pot marigold. Supplying Karkade plants with 54 kg K/fed. plus spraying them with 0.2% yeast was very effective in counteracting the adverse effects of water salinity on antitocynine and flavones in (1999) and 2000 seasons. The previous adverse effects of salinity on growth and chemical composition of the Karkode plants might be attributed to its effect on increasing soil osmotic pressure and limiting water and nutrient availability. Also, salt stress causes derangement of the normal metabolism of plant(Nijjar, 1985). The effect of K on alleviating the impaired effects of salinity on growth and chemical constituents might be ascribed to the beneficial effect of K on regulating the opening and closing of stomata that is essential for water transport, increasing root growth, maintaining turgor and reducing water loss, wilting and respiration (Dibb, 1998). The higher content of yeast front amino acids, minerals, cytokinine and vitamin B could explain the positive action of it on growth and composition of plants (NRP, 1977).

Under irrigation with saline water conditions, it is recommended for using 54 kg k/fed plus 0.2% yeast three times for obtaining vigorus karkade plant. This promising treatment was favourable, for counteracting the adverse effects of water salinity on growth and chemical constituents of *Hibiscus sabdariffa* L.

Table (4): Effect of various potassium levels and active dry yeast concentrations on fresh weight of leaves/plant (g), fresh weight of stem/plant (g) and fresh weight of roots/plant (g) of *Hibiscus sabdariffa* L. plants during 1999 and 2000 seasons.

Character K levels and Concentration (A)	Active dry yeast concentrations (B)							
	1999				2000			
	0.0%	0.2%	0.4%	Mean	0.0%	0.2%	0.4%	Mean
Fresh weight of leaves /plant (g)								
K at 0.0 kg/fed.	35.0	37.0	37.5	36.5	36.0	37.5	37.9	37.1
K at 18 kg/fed.	41.3	48.3	49.0	46.2	42.3	46.3	47.0	45.2
K at 36 kg/fed.	46.8	51.0	51.5	49.8	45.9	48.8	49.0	47.9
K at 54 kg/fed.	49.3	55.6	56.0	53.6	48.3	55.9	56.3	53.5
K at 72 kg/fed.	50.0	55.8	56.0	53.9	49.0	56.0	56.5	53.8
Mean (B)	44.5	49.5	50.0		44.3	48.9	49.3	
LSD at 5%	A 2.3	B 1.8	AB 4.5		A 2.0	B 1.7	AB 3.8	
Fresh weight of stem/plant (g)								
K at 0.0 kg/fed.	91.0	93.3	93.5	92.6	90.0	93.3	94.0	92.4
K at 18 kg/fed.	95.3	98.5	99.0	97.6	94.0	97.0	97.5	96.2
K at 36 kg/fed.	98.3	102.0	102.2	100.8	99.0	103.0	105.6	101.9
K at 54 kg/fed.	102.0	105.3	105.9	104.4	103.3	106.5	107.0	105.6
K at 72 kg/fed.	102.3	105.5	106.0	104.6	103.4	107.0	107.5	106.0
Mean (B)	97.8	100.9	101.3		97.9	101.4	101.9	
LSD at 5%	A 3.3	B 2.0	AB 4.5		A 3.0	B 1.8	AB 4.0	
Fresh weight of roots/plant (g)								
K at 0.0 kg/fed.	13.0	14.2	14.3	13.8	14.2	15.8	15.9	15.3
K at 18 kg/fed.	14.3	15.9	16.0	15.4	15.3	16.9	17.0	16.4
K at 36 kg/fed.	15.9	16.9	17.0	16.6	17.2	17.9	18.0	17.7
K at 54 kg/fed.	16.9	18.3	18.5	17.9	19.4	21.2	21.3	20.6
K at 72 kg/fed.	17.0	18.4	18.6	18.0	19.9	20.0	20.2	20.0
Mean (B)	15.4	16.7	16.9		17.2	18.4	18.5	
LSD at 5%	A 0.8	B 0.6	AB 1.3		A 0.6	B 0.5	AB 1.1	

aethiopica, Singh and Singh (1990) on guar.

The counteracting effects of K on the inferior effects of water salinity were emphasized by the results of Balbaa (1982), Zidan and Malibari (1993) and El-Fakhrani (2001) on potato plant.

Irrigation Karkade plants with saline water accompanied with using yeast at 0.2 to 0.4% was very effective in improving fresh and dry weights of leaves , stem, roots, sepals and fruits compared to irrigation with saline water without employing yeast. Increasing yeast concentrations from 0.0 to 0.4% was followed by a gradual stimulation on such growth criteria. Raising yeast concentrations from 0.2% to 0.4% caused insignificant increase on such growth traits. These results were true in both seasons.

The enhancing effect of yeast on fresh and dry weights of leaves roots, stems, sepals and fruits per plant was confirmed by the results of Wange (1996) on carrot, Ahmed *et al.* (1997) on grapevines, Ahmed *et al.* (1998) on Roselle and Ali (2001) on pot marigold.

The interaction between K and yeast on the aforementioned growth parameters of the plants grown under saline conditions clarified the necessity of these two nutrients for plants grown under such unfavourable conditions. The maximum values of these growth aspects with saline on plants irrigated were obtained groundwater and received 54 kg K/fed. plus 0.2% yeast. However, the minimum values were detected on the plants irrigated with saline groundwater and did not receive K fertilization and yeast. These results were true in both seasons.

3- Effect of K and yeast on anthocyanine and flavones of the plants:

Data in Table (7) clearly show that plants unfertilized with K and irrigated with saline ground water had the lowest content of anthocyanine and flovones compared to those fertilized with K and irrigated with saline groundwater. Increasing K levels from 0.0 to 72 kg k/fed was followed by gradual promotion on anthocyanine and flavones content. No significant differences were observed between using 54 and 72 kg k/fed on such pigments in both seasons.

The effects of salinity on inhibiting the plant pigments was confirmed by the results of Maurcar and Temoat (1990) on *Eucalytus carneldulensis and Eucalyptus bicostata* and Farahat (1990) on *Schinus molle, & terebinthjfoilius* and *Myoporurn acurninaturn.*

The results of Nabih (1991) on *Freesia refracta,* Selim *et al.* (1993) on Roselle, Attia and Aly (1994) on Iris, Zile and Gupta (1996) on Dahlia cv Wild and Somida (1998) on *Nigella saliva* supported the improving effect of K on plant pigments.

The reliefying effect of K on the reducing effect of salinity on pigments was confirmed by the results of Bahbaa *et al.* (1982), Feigin (1985), Al-Omran (1987) Zidan and Malibari (1993) and El-Fakhrani (2001) on potato plants.

Results regarding the effect of yeast on anthocyanine and flavones of plants, clearly show that application of yeast to plants irrigated with saline groundwater was very necessary for promoting anthocyanine and flavones compared to unbiofertilization with yeast and irrigated with saline water. The stimulation on such two pigments was correlated with increasing the

Table (3): Effect of various potassium levels and active dry yeast concentrations on plant height, number of branches/plant and number of fruits/plant of *Hibiscus sabdariffa* L. plants during 1999 and 2000 seasons.

Character K levels and Concentration (A)	Active dry yeast concentrations (B)							
	1999				2000			
	0.0%	0.2%	0.4%	Mean	0.0%	0.2%	0.4%	Mean
Plant height (cm)								
K at 0.0 kg/fed.	77.5	79.9	80.0	79.1	80.3	82.5	83.0	81.9
K at 18 kg/fed.	81.8	84.3	85.0	83.7	86.0	88.9	89.0	88.0
K at 36 kg/fed.	86.3	89.9	90.3	88.8	92.3	94.5	95.0	93.9
K at 54 kg/fed.	92.0	94.3	95.0	93.8	96.9	98.9	99.3	98.4
K at 72 kg/fed.	93.3	95.0	95.5	94.6	97.0	99.9	99.9	98.9
Mean (B)	86.2	88.7	89.2		90.5	92.9	93.2	
LSD at 5%	A 2.2	B 1.6	AB 3.8		A 2.9	B 1.6	AB 3.6	
Number of branches / plant								
K at 0.0 kg/fed.	22.5	23.3	24.0	23.3	23.3	24.3	24.4	24.0
K at 18 kg/fed.	23.3	24.0	24.1	23.8	24.9	25.6	25.7	25.4
K at 36 kg/fed.	24.5	25.2	25.3	25.0	26.3	26.5	26.5	26.4
K at 54 kg/fed.	25.5	26.6	26.7	26.3	28.9	29.9	30.0	29.6
K at 72 kg/fed.	25.8	27.8	26.8	26.8	29.0	30.0	30.2	29.7
Mean (B)	24.3	25.4	25.4		26.5	27.3	27.4	
LSD at 5%	A 0.5	B 0.2	AB 0.45		A 0.5	B 0.3	AB 0.67	
Number of fruits / plant								
K at 0.0 kg/fed.	20.2	21.0	21.2	20.8	21.0	21.9	22.0	21.6
K at 18 kg/fed.	20.9	21.6	21.7	21.4	22.4	23.0	23.2	22.9
K at 36 kg/fed.	22.1	22.7	22.9	22.6	23.7	24.3	24.4	24.1
K at 54 kg/fed.	23.3	23.9	24.0	23.7	26.0	27.0	27.1	26.7
K at 72 kg/fed.	23.4	24.0	24.1	23.8	26.2	27.1	27.2	26.8
Mean (B)	22.0	22.6	22.8		23.9	24.7	24.8	
LSD at 5%	A 0.5	B 0.3	AB 0.67		A 0.4	B 0.3	AB 0.67	

2- Effect of K and yeast on fresh and dry weights of leaves, stem, roots, sepals and fruits per plant:

Data in Tables (4 & 5 & 6 & 7) clearly show that fresh and dry weights of leaves, stein, roots, sepals and fruits per plant were negatively affected in plants grown under water salinity and did not receive K compared to those under salinity conditions and treated, with K at 18 to 72 kg/fed. There was a gradual promotion on such aspects with increasing K levels. Significant differences on growth parameters were detected between various K levels except between using 54 and 72 kg k/fed. These results were true in both seasons.

The impaired effects of water salinity on fresh and dry weights of leaves, stem, leaves, sepals and fruits particularly under unfertilization with K are in agreement with those obtained by Fathi (1989) on apples, Maurcar and Temoat (1990) on *Eucalyptus_cameldulensis* and *Eucalyptus bicostata* and Farhai (1990) on *Schinus molle, S. terebinihfolius* and *Myoporum acurninatum.*

The stimulating effect of K on growth aspects was confirmed by the results of Badran (1988) on tuberosa, Badran *et al.* (1989) on *Zantedeschia*

Table (2): Chemical composition of the groundwater used for irrigation.

Character	Value
PH (1:2.5 extract)	7.41
EC (1:2.5 extract) mmhos / 1 cm at 25 °C	2.44
Ion concentrations (meq l^{-1})	
HCO_3^-	3.20
Cl^-	7.00
$SO_4^=$	4.50
Ca^{++}	4.80
Mg^{++}	2.15
Na^+	7.50
K^+	0.21
SAR	4.03

RESULTS AND DISCUSSION

1-Effect of K and yeast on plant height and number of branches and fruits per plant:.

It is clear from the data in Table (3) that fertilizing Karkade plants grown under saline conditions with K at 18 to 72 kg/fed significantly improved plant height and number of branches and fruits per plant compared to unfertilization and irrigation with saline water. In other words, unfertilization with K and irrigation with saline water was responsible for reducing plant height and number of branches and fruits per plant compared to fertilization with K. Under salt conditions, the promotion on such growth parameters was associated with increasing K levels from 0.0 to 72 kg/fed. Significant differences were observed between all K levels except between using 50 and 72 kg/fed. These results were true in both seasons.

The adverse effects of water salinity on growth traits were supported by Sutarno (1984) on *Atnaranthus pencuatus* and Fathi (1989) on apples. The results of Mottial *et al.* on Galdiolus, Wahab and Hornok (1982) on *Osimum basilicum* and Badran (1988) on Tuberose, supported the improving effect of K on growth. The beneficial of K on counteracting the adverse effects of water salinity on growth was confirmed by the results of Bernstein *et at.* (1974) on vegetables, Balbaa *et* at (1982); Feigin (1982) and El- Fakhrani (2001) on potato plants.

Data concerning the effect of yeast on such criteria clearly show that there was a gradual stimulation on plant height and number of branches and fruits per plant with increasing yeast concentrations from 0.0 to 0.4%. Neglected and insignificant increase in such aspects was observed between spraying 0.2 and 0.4%. Plants irrigated with saline groundwater and did not receive yeast had the minimum height and borne fewer number of branches and fruits as compared to those biofertilized with yeast. These results were true in both seasons.

The beneficial effect of yeast on growth parameters was emphasized by the results of Wange (1996) on carrot, Ahmed *et al.* (1998) on Roselle and Ali (2001) on pot marigold. The interaction between K and yeast caused a pronounced effect on plant height and number of branches and fruits per plant since the maximum values were produced due to combined application of 54 kg k/fed. plus spraying 0.2% yeast. Plants under water salinity and did not receive K and yeast produced the minimum values in 1999 and 2000 seasons.

18 Kg K/fed, (a_3) 36 kg K/fed, (a_4) 54 kg K/fed and (a_5) 72 kg K/fed. The second factor (B) that represented the sub-plots consisted from three concentrations of active dry yeast i.e., (b_1) 0.0% , (b_2) 0.2% and (b_3) 0.4%.

Therefore, the experiment included fifteen treatments, each replicated three times one plot per each. Potassium was added in the form of potassium sulphate (48% K_2O). Active dry yeast solutions at all concentrations used were carefully prepared before spraying by adding about 10 g sucrose / L solution for activating the reproduction of yeast. The definite amount of active dry yeast was dissolved in 10 L warm water (38 ^{o}C) followed by the addition of 100 g sucrose / 10 L water and let stand for ten minutes before spraying. Triton B as a wetting agent at 0.1% was added to all solutions. Application of potassium and active dry yeast were established three times at 45, 90 and 135 days from sowing to cover completely the plant foliage (200 litre/fed). The plants received calcium superphosphate (15.5% P_2O_5) and ammonium sulphate (20.6% N) at rates of 100 and 150 kg/fed, respectively at three batches at three weeks intervals starting mid. June in both seasons. Other agricultural practices were followed as usual.

At harvest time the following growth parameters and yield components were recorded : 1- Plant height (in cm)

2- Number of branches and fruits per plant

3- Fresh and dry weights of leaves, stems, roots, fruits as well as sepals

4- Anthocyanine and floavones content were estimated according to Fahmy (1970) and De-Losser (1970)

All the obtained data were tabulated and statistically analyzed according to Snedecor and Cochran (1973) . For comparison between various treatment means L.S.D test was used.

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

Character	Value
Particle size distribution (%):	
Sand	96.0
Silt	1.1
Clay	2.9
Texture	Sandy
PH (1:2.5 extract)	8.02
EC (1:2.5 extract) mmhos / 1 cm at 25 °C	0.85
$CaCO_3$ (%)	5.0
O.M. (%)	0.123
Ion concentrations (meq l^{-1})	
HCO_3^-	3.20
Cl^-	3.18
$SO_4^=$	1.70
Ca^{++}	3.40
Mg^{++}	0.50
Na^+	3.91
K^+	0.35
Total N (%)	0.01
Available P (ppm, Olsen)	16.5
Available K (ppm, ammonium acetate)	38.0

allocation, iron relations, water status, physiological processes, biochemical reactions and/or a combination of such factors (Zidan and Maliba, Malibari, 1993).

The adverse effects of salinity on growth, yield and chemical constituents was reported by the results of Sutarno (1984) on *Antaranthus peniculatus*, Fathi (1989) on apples, Maurcar and Temoot (1990) on *Eucalyptus carnaldulensis* and *E. bicostata* and Farahat (1990) on *Schinus molle*, S. *terebinthifolius* and *Myoporum acurninaturn*.

Many factors can affect the salt tolerance of plants. Fertilizer application can also be of importance in salt tolerance of plant. The fertilizer element of most significant in salt tolerance is potassium (Bernstein *et al.*, 1974, Balba *et al.*, 1982, Feigin, 1985, Abdelaal *et al., 1997,* Abdelaal and Ahmed 2001 and El-Fakhrani, 2001). The alleviating effects of potassium on salinity might be attributed to its effect on regulating the opening and closing of stomata that is essential for water transport, increasing root growth, maintaining turgor and reducing water loss, wilting and respiration (Dibb, 1998).

The outstanding effect of K on growth, yield and chemical constituents of horticultural plants was supported by Mottial *et al.* (1979) on galdiouls, Wahab and Hornok (1982) on Osimum basilicum, Koriesh *et* at, (1983) on Cyperus esculentus, Kariesh and Badawy (1984) on Freesia retracta, Potti and Arora (1986) on galdiouls cv. sylvia, Badran (1988) on tuberosa, Singh and Singh (1990) on guar, Nabih (1991) Freesia refracta Cv., Selim et al.(1993) on roselle; Attia and Aly (1994) on Iris; Zile and Gupta (1996) on Dahlia cv. Wild and Somida (1998) on *Nigella sativa*..

Application of active dry yeast was beneficial in improving growth and chemical constituents of various horticultural crops particularly those grown under salt stress conditions (Wange, 1996 on carrot, Ahmed *et at.*,(1997) on grapevines, Ahmed *et at.* 1998 on Roselle and Ali, 2001 on pot marigold. According to NRP (1977) yeast is very rich in various essential amino acids, cytokinins and vitamin B.

The objective of this study was to examine the effect of potassium and yeast as means for promoting the salt tolerance *of Hibisus sabdariffa* plants to irrigation with saline groundwater.

MATERIALS AND METHODS

The present work was conducted at the Experimental Farm of king Ab dulaziz Univ. at Hoda Al-Sham located 120 km northeast of Jeddah, Saudi Ahtbia during 1994 and 2000 seasons. The texture of the tested soil is sandy Physical and chemical analysis of the soil were determined according to Page *et at.* (1982) the obtained data are shown in Table (1).

Plants were irrigated with groundwater. Chemical analysis of the groundwater used for irrigation are given in Table (2).

Seeds of karkade were sown on the first week of May in both seasons. Each plot was 2.4 x 5.4 m and contained 8 rows 60 cm apart. The distance between the plants were 60 cm.

The experiment involved two factors. The first factor (A) which occupied the main plots comprised from five potassium levels i.e (a_1) 0.0 kg K/fed., (a_2)

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EFFECT OF FERTILIZATION WITH POTASSIUM AND BIOFERTILIZATION WITH YEAST ON THE TOLERANCE OF *HIBISCUS SABDARIFFA* L. PLANTS TO IRRIGATION WITH SALINE WATER

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ABSTRACT

The present work was conducted during two successive seasons of 1999 and 2000 at the Agricultural Research Station of king Abdulaziz Univ. at Hoda Al-Sham area, Saudi Arabia to study the effect of using five levels of potassium (0.0, 18.0, 36.0, 54.0 and 72.0 kg K/fed) and/or three concentrations of yeast (0.0, 0.2 and 0.4%) on plant height, number of branches and fruits per plant, fresh and dry weights of leaves, stem, roots, sepals and fruits, anthocyanines and flavones of *Hibiscus sabdariffa* L plants irrigated with saline groundwater (EC. 2.44 dSm^{-1}). Soil application of K and spraying yeast were done three times at 45,90 and 135 days from sowing.

Results showed that using K and yeast was very effective in enhancing all growth criteria, anthocyanine and flavones compared to untreated and irrigated with saline water plants. The promotion on the studied parameters was associated with increasing K levels from 0.0 to 72.0 kg/fed and Yeast concentrations from 0.0 to 0.4% .Meaningless increase of the investigated characters was observed between the higher two doses of K and the higher two concentrations of yeast.

One can state that supplying *Hibiscus sttbdariffa* plants grown under saline conditions with K at 54 kg/fed incorporated with spraying 0.2% yeast three times was necessary for alleviating the adverse effects of water salinity on growth traits and chemical constituents.

INTRODUCTION

Hibiscus sabdariffa L. is a subtropical plant which is known under the name of Karkade in many regions in Arab world. The extraction of fleshy epicalyx and calyx of fruits is used in food industry and cosmetics. This extract acts as antispasmodic as well as antihypertensive without producing side effects. It is also favorable as diuretic, diaphoretic and euphoretic. The extract is also used for weight reduction. The great benefits and merits of Karkade encouraged workers for finding out the trials for improving yield particularly when grown under unfavorable soil and when irrigated with saline water.

In Saudi Arabia, the water resources for agriculture are very limited. Groundwater salinity is relatively medium to high (Al-Omjynd, 1987). Salinity of groundwater in Wadi Hada Al-Sham and most Saudi Arabia regions varied all the year from 0.33 to more than 10 dSm^{-1}. The use of saline water for irrigation caused an adverse effects on physical and chemical properties of the soils and ultimately impaired plant growth and development (Nijjar, 1985 . Mostafa *et al.*, 1992 and El-Fakhrani, 2001. The reduction in growth of ornamental plants by salinity may result from its effects on dry matter