

RE-USE OF DRAINAGE WATER AND ITS EFFECT ON SOIL SALINITY STATUS UNDER SUGAR BEET

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Abstract

The aim of this paper is to study the possibility of reusing drainage water successfully without hazardous consequences on soil properties. A pot experiment was conducted at the Agricultural Research Center Experimental Field at Giza. Irrigation waters were of 3 levels of salinities 1000, 2000 and 3000 ppm and were added into soils for three periods 4, 5 and/or 6 months in addition to the control (fresh water for 6 months). Results showed the possibility of the re-use of drainage water for irrigating sugar beet crop. No significant differences in yield occurred when irrigation waters of salinities 1000, 2000 and 3000 ppm were used. No problems were developed of soil degradation e.g. salinity, sodicity and/or permeability were observed when these waters were used for 4, 5 and / or 6 months.

INTRODUCTION

The water budget in Egypt is limited by the country's share of the Nile water which is fixed according to an international agreement at 55.5 billion m³ per year in addition to low quantities of groundwater and precipitation over the north-west and north-east coastal areas.

At the present time a quantity of drainage water estimated at 13.5 billion

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m³/year, of reasonable quality, flows unused to the Mediterranean Sea and the coastal lakes which are in direct connection with the sea. Part of this water could, and should, be re-used for irrigation purposes so that the country can overcome the shortage in agricultural production, and would reduce the amount of brackish water and salt load discharged into receiving waters. Earlier reports of Rhoades *et al.* (1988), Rhoades, (1977, 1984, 1987), Meiri *et al.* (1986), Grattan *et al.* (1987), Shennan *et al.* (1987) Ayars *et al.* (1986 a), Rains *et al.* (1987) have concluded that the use of saline waters for irrigation is feasible, especially when waters are alternated or combined with good-quality water supplies. This option is being seriously considered in parts of India (Gupta, personal communication) and Israel (shalhevet, 1984).

The aim of this paper is to study the ability of re-using drainage water successfully without hazardous consequences on soil properties cultivated with sugar beet.

MATERIALS AND METHODS

A pot experiment was conducted at the Agricultural Research Centre Experimental Field at Giza using a clay loam soil treated with ten irrigation water with various levels of salinity:

1. Fresh water for whole season (control).
2. Fresh water for first two months followed by water containing 1000 ppm.
3. Fresh water for first month followed by 1000 ppm.
4. 1000 ppm for the whole season.
5. 1000 ppm for the first two months followed by 2000 ppm.
6. 1000 ppm for the first month followed by 2000 ppm.
7. 2000 ppm for the whole season.
8. 2000 ppm for the first two months followed by 3000 ppm.
9. 2000 ppm for the first month followed by 3000 ppm.
10. 3000 ppm for the whole season.

The initial soil used is nonsaline (electrical conductivity of 1.4 ds/m of the

soil saturation extract). Table 1 shows the composition of waters used for irrigation. The treatments were arranged in a split plot design and were replicated twenty four times. Sugar beet was planted on September 29, 1990 in pots of 40 cm diameter, 50 cm height and irrigated after approximately 30 mm of crop evapotranspiration (ET_c) which was accumulated using daily values of ET_c . Daily values of ET_c were calculated through potential evapotranspiration values calculated by the modified Penman equation using climatic data collected on-site. Forty two irrigations were applied during the season. The sugar beet was harvested on 20 April 1991. Soil samples were taken from the root zone. The samples were crushed, air dried, passed through a 2.0 mm sieve, and saturated soil paste extract was analysed according to U.S. Salinity Laboratory Staff (1954) for electrical conductivity, anions and cations.

Exchangeable cations Ca, Mg, Na and K were determined following the U.S.S.L.S. (1954) procedures.

Sodium adsorption ratio (SAR) and exchangeable sodium percentage (ESP) parameters were calculated. Soil permeability was determined in the laboratory, after Milton Fireman (1944).

RESULTS AND DISCUSSION

1- Sugar beet yield :

No significant differences in yield occurred when irrigation waters with salinities 1000, 2000 and 3000 were used for 4, 5 and 6 months. This means that saline water with salinities up to 3000 ppm can be safely used to irrigate sugar beet crop (Fig. 1).

2-Soil salinity :

Salinity is expressed in terms of the electrical conductivity of the saturated soil paste extract (EC_e) ds/m.

Average salinity values at the end of the sugar beet crop (Fig. 2) in the differ-

Table 1. Composition of waters used for irrigation (meq./L).

Treatment	EC dS/m	ppm	CO_3^{--}	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^{++}	K^+	SAR
Fresh Tr.1	0.40	260	-	3.1	1.5	0.1	1.9	1.5	1.1	0.2	0.8
Mixed Tr.2	1.40	1000	-	3.1	10.5	0.2	2.5	3.3	7.7	0.3	4.5
Mixed Tr.3	3.00	2000	-	3.1	24.1	0.5	2.9	6.6	17.5	0.4	8.1
Mixed Tr.4	4.50	3000	-	3.1	35.3	0.8	3.5	10.0	25.0	0.7	9.7

ent treatments were below the threshold level (7 ds/m) associated with sugar beet reduction (Maas 1986). Therefore, no reduction of yield had resulted

Moreover, the EC_e values did not differ greatly when irrigation water having 1000, 2000 and 3000 ppm salts concentrations were used, whereas they were almost constant within each concentration when it was used for 4, 5, or 6 months.

3- Soil Sodicities :

Sodicity is expressed as the sodium adsorption ratio of the extract and the exchangeable sodium percentage (Figs. 3 & 4). Average sodicity values at the end of the sugar beet crop were below the critical levels of alkalinity (15 for SAR and ESP) when irrigation water with salinities 1000, 2000 and 3000 ppm were used for 4, 5 or 6 months. The resultant combinations of SAR, ESP on one hand and the EC_{1w} on the other hand did not cause reduction of soil permeability (Fig. 5). This result is in close agreement with that obtained by (Rhoades 1984, 1986).

REFERENCES

1. Ayars, J.E., R. B. Hutmacher, R. A. Schoneman, S. S. Vail, and D. Felleke. 1986.a . " Drip irrigation of cotton with saline drainage water ". Transactions of the ASAE, 29 (6) : 1668-1673.
2. Grattan, S. R., C. Shennan, D.M. May, J. P. Mitchell, and R. G. Burau. 1987. "Use of drainage water for irrigation of melons and tomatoes". California Agriculture, 41 (9/10) : 27-28.
3. Maas, E. V. 1986. Salt tolerance of plants. Applied Agric. Res., 1(1):12-26.
4. Meiri, A., J. Shalhevet, L. H. Stolzy, G. Sinaf, and R. Steinhardt. 1986. " Managing multi-source irrigation water of different salinities for optimum crop production". BARD Technical Report 1-402-81. Volcani Centre, Bet Dagan, Israel, 172 pp.
5. Milton, Fireman. 1944. Permeability measurements on disturbed soil samples. Soil Sci., 58 : 337-353.

6. Rains, D. W. S. Goyal, R. Weyranch, and A. Lauchli 1987. Saline drainage water reuse in a cotton rotation system". California Agriculture, 41 (9/10):24-26.
7. Rhoades, J. D. 1977. Potential for using saline agricultural drainage waters for irrigation. Proc. Water Management for irrigation and Drainage, ASCE, Reno, Nevada, July 1977, pp. 85-116.
8. Rhoades, J. D. 1984. Use of saline water for irrigation. California Agriculture, 38 (10): 42-43.
9. Rhoades, J. D. 1986. Use of saline water for irrigation. Special issue Bull. Water Quality Burlington, Ontario Canada National water Res. Inst.
10. Rhoades, J. D. 1987. Use of saline water for irrigation. Water quality Bulletin 12:14-20.
11. Rhoades, J. D., F. T. Bingham, J. Letey; G. I. Hoffman, A. R. Dedrich, P. J. Pinter, and J. A. Replogle. 1988. Use of saline drainage water for irrigation: Imperial Valley Study. Agricultural Water Managements (In press).
12. Shalhevet, J. 1984, Management of irrigation with brackish water. Soil Salinity Under Irrigation, Processes and Management. Shainberg, I. and Shalhvet, J., eds. Springer-Verlag, pp. 298-318.
13. Shennan, C., S. Grattan, D. May, R. Burau, and B. Hanson. 1987. Potential for the long-term cyclic use of saline drainage water for the production of vegetable crops. Technical Progress Report, U. C. Salinity/Drainage Task Force, Div. of AG. and Natural Resour., Univ. of Calif., Davis, pp. 142-146.
14. U. S. Salinity Laboratory Staff 1954. L. A. Richards, ed. Diagnosis and Improvement of Saline and Alkali soils. U. S. Dept. of Agric. Handbook No. 60.

تأثير إعادة إستخدام مياه الصرف على خواص التربة عند زراعة بنجر السكر

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الغرض من هذا البحث دراسة إمكانية إعادة استخدام مياه الصرف بنجاح بدون تأثير ضار على خواص الأرض المنزرعة بنجر السكر .

أقيمت تجربة قصارى بمزرعة تجارب مركز البحوث الزراعية بالجيزة لإستخدام ثلاث تركيزات من مياه الري ١٠٠٠ ، ٢٠٠٠ ، ٣٠٠٠ جزء / مليون لمدة ٤ ، ٥ ، ٦ شهور بالإضافة الى معاملة المقارنة بإستخدام مياه النيل لمدة ٦ شهور .

وتؤيد النتائج المتحصل عليها إمكانية استخدام مياه الصرف حتى تركيز ٣ آلاف جزء / مليون فى أغراض الري لحصول بنجر السكر حيث لم يكن هناك تأثير ضار معنوى على محصول بنجر السكر ...

كذلك لم يظهر أثر ضار على الأراضى سواء فى الملوحة أو القلوية أو النفاذية عند إستخدام هذه التركيزات - كذلك لم يكن هناك فرق يذكر عند إختلاف مدة إستخدامها .