



شبكة المعلومات الجامعية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ





شبكة المعلومات الجامعية



# شبكة المعلومات الجامعية

## التوثيق الالكتروني والميكرو فيلم

# جامعة عين شمس

التوثيق الالكتروني والميكرو فيلم

## قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها  
علي هذه الأفلام قد اعدت دون أية تغيرات



## يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of  
15 – 25c and relative humidity 20-40 %



شبكة المعلومات الجامعية



# بعض الوثائق الأصلية تالفة



شبكة المعلومات الجامعية



بالرسالة صفحات  
لم ترد بالأصل



**Effect of Irrigation Water Quality and Soil  
Amendments on Physico-Chemical  
Properties of Some Egyptian Soils**

**By**

**Ahmed Ibrahim Mohamed Ahmed**  
**B.Sc. Agricultural Sciences (Soils and Water) 1994**  
**M.Sc. Agricultural Sciences (Soils) 2000**

***Thesis***

**Submitted in Partial Fulfillment of the  
Requirements for the Degree  
Of  
Doctoral of Philosophy**

**In  
Agricultural Sciences  
(Soils)**

**To  
Soil and Water Department  
Faculty of Agriculture  
Suez Canal University  
2006**

0-19

**Effect of Irrigation Water Quality and Soil  
Amendments on Physico-Chemical  
Properties of Some Egyptian Soils**

**By**

**Ahmed Ibrahim Mohamed Ahmed**  
**B.Sc. Agricultural Sciences (Soils and Water) 1994**  
**M.Sc. Agricultural Sciences (Soils) 2000**

***Thesis***

**Submitted in Partial Fulfillment of the  
Requirements for the Degree  
Of  
Doctoral of Philosophy**

**In  
Agricultural Sciences  
(Soils)**

**To  
Soil and Water Department  
Faculty of Agriculture  
Suez Canal University**

**2006**

## **APPROVAL SHEET**

### **Effect of Irrigation Water Quality and Soil Amendments on Physico-Chemical Properties of Some Egyptian Soils**

*Ph.D. Thesis*

**By**

**Ahmed Ibrahim Mohamed Ahmed**

B.Sc. Agricultural Sciences (Soils and Water) 1994

M.Sc. Agricultural Sciences (Soils) 2000

### **APPROVED BY**

**Prof. Dr. Saber Abdou Gaheen** ..... *S.A. Gaheen*  
Prof. of soil science  
Faculty of Agriculture  
Kafer Alshikh University

**Prof. Dr. Samier Abd El-Wahab Abou El-Roos** ..... *Abou El-Roos*  
Prof. of Soil Science  
Faculty of Agriculture  
Cairo University

**Prof. Dr. Ozoris Mohamed Ali** ..... *Ozoris M.A*  
Prof. of Soil Science  
Faculty of Agriculture  
Suez Canal University

**Prof. Dr. Mohamed Ahmed Nasr** ..... *Nasr M.A*  
Prof. of Soil Science  
Faculty of Agriculture  
Suez Canal University

Date: 15 / 11 /2006

Name	Ahmed Ibrahim Mohamed Ahmed
Title	Effect of Irrigation Water Quality and Soil Amendments on Physico-Chemical Properties of Some Egyptian Soils
Faculty	Agriculture- Ismalia
Department	Soil and Water
Location	Suez Canal University
Degree	Doctor of Philosophy
Date	15 / 11 / 2006
Language	English
Supervision Committee	Prof. Dr. Ozoris Mohamed Mohamed Ali Prof. Dr. Mohamed Ahmed Nasr Matloub Prof. Dr. Abdel Monem Mahmoud Zayed

### **Abstract**

A lysimeter experiment was carried out, to study the effect of organic and inorganic soil amendments, and saline irrigation water, on some physical and chemical properties of calcareous, alluvial and sandy soils, as well as, the plant growth and its chemical composition. The application of soil amendments significantly, decreased the soil bulk density and the modulus of rupture, in each of surface and subsurface soils, while, salinity of irrigation water upto 6000 ppm, increased them. Soil hydraulic conductivity of surface and subsurface soils significantly increased, under application of soil amendments with Nile water (control). While, significantly decreased with different salinity levels of irrigation water. The application of soil amendments decreased E<sub>ce</sub>, SAR, ESP and swelling factor, while these parameters were increased with increasing salinity levels in the irrigation water. The determined leaching fraction decreased with the application of soil amendments, relative to the estimated leaching fraction, and increased with increasing salinity levels in the irrigation water.

The application of soil amendments and salinity in the irrigation water increased the NPK availability in different soils. The saline irrigation water upto 6000 ppm, decreased the fresh and dry weights of alfalfa and sorghum plants. The efficiency of soil amendments on reducing salinity hazard on the fresh and dry weights of alfalfa and sorghum plants could be arranged as follows: (1) sulphur > town refuse > sewage sludge for calcareous soil. (2) Town refuse > sewage sludge > sulphur for alluvial soil, and (3) sewage sludge > town refuse > sulphur for sandy soil. Results also showed that, the elemental sulphur was the best soil amendments for increasing NPK and Na content, and total uptake of alfalfa and sorghum plants cultivated in calcareous soil. While, the town refuse and sewage sludge were the best for alluvial and sandy soils.

**Key words:** water salinity, sewage sludge, town refuse, sulphur, soil physical and chemical properties, alfalfa, sorghum, NPK and Na content and total uptake.

# **ACKNOWLEDGEMENT**

## **ACKNOWLEDGEMENT**

The author wishes to express his sincere gratitude, and deepest appreciation to the principal advisor **Prof. Dr. OZORIS MOHAMED ALI**, professor of soil science, Faculty of Agriculture, Suez Canal University, for his careful continuous supervision, selecting the problems of this study, guidance and continuous encouragement, and valuable help in accomplishing the study.

Gratitude's are also due to **Prof. Dr. MOHAMED AHMED NASR**, professor of soil science, soil & water Department, Faculty of Agriculture, Suez Canal University, for his efforts and sincere help, in providing all needed facilities and his supervision in this study.

Thanks are also due to **Prof. Dr. ABDEL MONEAM ZAYED**, professor of soil science, soil & water Department, Faculty of Agriculture, Suez Canal University, for providing early supervision before his departure to Libya.

Special thanks are also due to all **STAFF MEMBERS** of Soil and Water Department, Faculty of Agriculture, Suez Canal University, for helpful co-operation, and supplying all facilities to accomplish this investigation.

## **Contents**

<b>No.</b>	<b>Subject</b>	<b>Page</b>
1.	Introduction	1
2.	Review of literature	4
2.1.	Effect of saline irrigation water and some soil amendments on the physical properties of the soils.	5
2.1.1.	Bulk density	6
2.1.2.	Modulus of rupture	10
2.1.3.	Saturated hydraulic conductivity	14
2.2.	Effect of saline irrigation water and some soil amendments on the chemical properties of the soils.	23
2.2.1.	Soil salinity	24
2.2.2.	Soil reaction	29
2.2.3.	Exchangeable Sodium Percentage (ESP) and Sodium Adsorption Ratio (SAR)	32
2.3.	Effect of saline irrigation water and some soil amendments on the leaching fraction.	38
2.4.	Effect of saline irrigation water and some soil amendments on the availability of N, P and K.	43
2.5.	Effect of saline irrigation water and some soil amendments on plant growth and its composition.	46
3.	Materials and methods	49
3.1.	Materials	49
3.1.1.	Soils	49
3.1.2.	Soil amendments	49
3.1.3.	Irrigation water	49
3.1.4.	Lysimeter Experiment	49
3.1.5.	Leaching experiment	50
3.2.	Methods of analyses	52

<b>No.</b>	<b>Subject</b>	<b>Page</b>
3.2.1.	Soil analyses	52
3.2.2	Plant analyses	54
3.3.	Statistical analysis	54
4.	Results and Discussion	55
4.1.	The Physical and Chemical Properties of Investigated Soils before Cropping.	55
4.2.	The Effect of Saline Irrigation Water and Soil Amendments on Some Physical Properties of the Investigated Soils After Cropping.	59
4.2.1.	Bulk density	59
4.2.2.	Modulus of rupture (MOR)	68
4.2.3.	Saturated hydraulic conductivity	76
4.3.	Effect of Saline Irrigation Water and Soil Amendments on Some Chemical Properties of Investigated Soils After Cropping.	84
4.3.1.	Soil salinity ( $EC_e$ )	89
4.3.2.	Sodium Adsorption Ratio (SAR)	96
4.3.3.	Exchangeable sodium percentage (ESP)	98
4.3.4.	The Relationship between ESP and/or SAR and $EC_e$ (swelling factor).	100
4.4.	Effect of Saline Irrigation Water and Some Soil Amendments on the Leaching Fraction of the Investigated Soils.	103
4.5.	Effect of Saline Irrigation Water and Some Soil Amendments on the Availability of N, P and K of the Investigated Soils.	111
4.5.1.	Available-N	111
4.5.2.	Available-P	114
4.5.3.	Available-K	116

<b>No.</b>	<b>Subject</b>	<b>Page</b>
4.6.	Effect of Saline Irrigation Water and Some Soil Amendments on Some Parameters of Alfalfa and Sorghum Plants Cultivated in the Investigated Soils.	117
4.6.1.	The Fresh and Dry Weights of Alfalfa and Sorghum Plants.	117
4.6.2.	Estimated yield potential of alfalfa and sorghum plants.	124
4.6.3.	Effect of Saline Irrigation Water and Soil Amendments on the N, P, K and Na content of Alfalfa and Sorghum Plants.	130
4.6.3.1.	Nitrogen Content.	130
4.6.3.2.	Phosphorus Content.	137
4.6.3.3.	Potassium Content.	137
4.6.3.4.	Sodium Content.	138
4.6.4.	Effect of Saline Irrigation Water and Soil Amendments on the Total Uptake of N, P, K and Na of Alfalfa and Sorghum Plants.	138
4.6.4.1.	Total N Uptake	138
4.6.4.2.	Total P Uptake	146
4.6.4.3.	Total K Uptake	147
4.6.4.4.	Total Na Uptake	148
5.	Summary and conclusion	150
6.	References	158
7.	Appendixes	177
8.	Arabic summary	201

## **List of Tables**

<b>Table No.</b>	<b>Subject</b>	<b>Page</b>
1	Some physical and chemical properties of the investigated soils before cropping.	56
2	Some chemical properties of organic amendments.	58
3	Some chemical properties of the Irrigation water.	58
4	Effect of saline irrigation water and soil amendments on the soil bulk density of the investigated soils after cropping.	60
5	Summary of variance analysis of soil physical properties	64
6	Effect of saline irrigation water and soil amendments on the soil modulus of rupture (millibars) after cropping.	69
7	Effect of saline irrigation water and soil amendments on the soil saturated hydraulic conductivity ( $\text{cm h}^{-1}$ ) after cropping.	77
8	Effect of saline irrigation water and soil amendments on different dissolved cations in the soil paste extract after cropping.	85
9	Effect of saline irrigation water and soil amendments on exchangeable sodium and cation exchangeable capacity after cropping.	87
10	Effect of saline irrigation water and soil amendments on the difference between estimated (ECe) and determined (ECe) as well as the percentage of decrements.	91
11	Effect of saline irrigation water and soil amendments on SAR, ESP and swelling factor of investigated soils after cropping.	97
12	Effect of saline water and soil amendments on the average of the leaching fraction of 10 leachates of soils after cropping.	104
13	Effect of saline water and soil amendments on the average of the leaching fraction of 4 leachates of soils after cropping and equilibrated for two months.	109
14	Effect of saline irrigation water and soil amendments on availability of some nutrients in soils after cropping.	112