

**EFFECT OF SOIL MOISTURE ON THE
AVAILABILITY OF SOME MACRO AND
MICRO-ELEMENTS IN CALCAREOUS
SOILS OF EGYPT**

By

Mahmoud Ismail Abd El-Rahman

(B.Sc. in Agriculture, Faculty of Agriculture, Ain Shams University, 1974)

A thesis submitted in partial fulfilment

of

the requirements for the degree of

MASTER OF SCIENCE

in

Agriculture

(Soil Science)

Department of Soil Science
Faculty of Agriculture
Ain Shams University

1996



APPROVAL SHEET

**EFFECT OF SOIL MOISTURE ON THE AVAILABILITY
OF SOME MACRO AND MICRO-ELEMENTS
IN CALCAREOUS SOILS OF EGYPT**

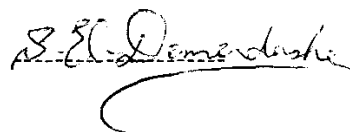
BY

Mahmoud Ismail Abd El-Rahman


B.Sc. Agriculture (Soil Science), Ain Shams Univ., 1974

This thesis for M.Sc. has been approved by:

Prof. Dr. Saad El-Demerdashe El-Kady
Prof. of Soil Science,
Desert Research Center



Prof. Dr. Abd El-Samad Salem Ismail
Prof. of Soil Science, Faculty of Agriculture,
Ain Shams University.



Prof. Dr. Mohamed Ahmed Mostafa
Prof. of Soil Science, Faculty of Agriculture,
Ain Shams University.



Date of examination: 13/12/1995

**EFFECT OF SOIL MOISTURE ON THE
AVAILABILITY OF SOME MACRO AND
MICRO-ELEMENTS IN CALCAREOUS SOILS
OF EGYPT**

By

Mahmoud Ismail Abd El-Rahman

(B.Sc. in Agriculture, Faculty of Agriculture, Ain Shams University, 1974)

Under the supervision of:

Prof. Dr. M. A. Mostafa

Prof. of Soil Science,
Ain Shams University

Prof. Dr. M.H. El-Desouky

Prof. of Soil Science,
Desert Research Center

ABSTRACT

EFFECT OF SOIL MOISTURE ON THE AVAILABILITY OF SOME MACRO AND MICRO-ELEMENTS IN CALCAREOUS SOILS OF EGYPT. Unpublished Master of Science in Agriculture, University of Ain Shams, 1995.

The work is undertaken to investigate, the effect of soil moisture depletion on the yield and elemental composition of tomato and barley plants grown on calcareous soils. For this purpose three pot experiments were carried out under controlled conditions.

The experiments dealt with tomato plants involved the effect of soil depletion and mineral fertilization or organic manuring along with the effect of method of irrigation, while the third experiment was cultivated with barley and treated with sludge manuring and irrigated with tap water or sludge effluents under three different moisture regimes.

From the obtained results, one can figure out that:

1. Increasing soil moisture depletion induced significant decreases on the yields of tomato and barley.
2. Application of mineral fertilizer, organic manure and sewage sludge led to significant increases in the yield of both tomato and barley.
3. Fertilization and manuring increased most plant elements in various magnitudes.
4. The combined treatments including soil moisture depletion, fertilization or manuring and irrigation method induced variable patterns of increase or decrease in macro and micro-nutrients concentrations and uptake in both plants, depending on the parameters included in such treatments.
5. The chemical extractable amounts of soil elements varied according to treatments.

From the foregoing results, it can be said that the maintenance of proper soil moisture is of profound importance for growing plants. This proper moisture furnishes the most favourite media for water availability to plants, elements reactivity, mobility and solubility, activity and population of microorganisms which accelerate the biodegradation of organic wastes and their contribution to elements chelation and release, all of which is reflected on the grown plants composition and yield. In the current

investigation, 25% soil moisture depletion was shown to be the most appropriate soil moisture level. Mineral fertilization is undoubtedly more effective on plant growth especially at the early stages and usually overcomes organic manuring from different sources (chicken or sewage sludge) due to the readily soluble nutrients from mineral fertilizers against the slow decay of organic matter and release of nutrients. This is reflected on the grown plants where the effect, of organic manuring is more indicated at the latter stages of growth. Nevertheless, combination of both organic manuring and mineral fertilization is the most recommended. Drip irrigation is shown to be the most effective method for irrigating tomato plants. This is expected due to the uniformity of water distribution in the root zone as well as the water use efficiency of the drip system.

In conclusion, the present investigation indicates that the best combined treatment is 25% soil moisture depletion with mineral fertilization (3rd rate) or organic manuring (2% of chicken manure or sewage sludge) under drip irrigation for tomato or sludge effluent irrigation for barley.

Key words: Tomato shoot, tomato fruits, organic manure, mineral fertilization, moisture depletion, irrigation method, barley plants, sewage sludge, sludge effluent, available macro and micro nutrient, calcareous soils.

ACKNOWLEDGEMENT

The author wishes to express his deep thanks, gratitude and appreciations to Prof. Dr. M. El-Nennah, Prof. of Soils, Fac. Agric., Ain Shams Univ., Prof. Dr. M. Mostafa, Prof. of Soils, Fac. Agric., Ain Shams Univ. and Prof. Dr. M. El-Desouky, Prof. of Soils, Desert Research Center, for suggesting the problem, supervision, guidance and constructive criticism throughout the course of study. Thanks are extended to Dr. M.S.A., Dahdoh and Dr. B.I.M. Moussa, Ass. Prof. of Soil Fertility and Plant Nutrition, Desert Research Center for sincere guidance and continual follow-up during such study.

Special thanks to Prof. Dr. M.Y. Afifi, Head of Soil Chemistry and Physics Department, Desert Research Center, for big valuable guidance and assistance.

The author is also indebted to the staff members of the Desert Research Center whose cooperation, assistance, advice and facilities provided are deeply appreciated.

CONTENTS

	Page
1. INTRODUCTION	1
2. REVIEW OF LITERATURE	2
2.1. Effect of soil moisture depletion on the yield and nutritional status of plants.....	2
2.2. Effect of organic manure on the yield and nutritional status of plants.	9
2.3. Effect of sewage application on some chemical properties of soil	13
2.3.1. Soil pH	13
2.3.2. Soluble salts in soil (EC)	14
2.3.3. Availability of heavy metals in soil	14
2.3.4. Soil physical properties	16
2.4. Effect of sewage sludge application on the yield and elemental composition of plants	17
3. MATERIALS AND METHODS	23
3.1. First experiment: Effect of soil moisture depletion, irrigation method and mineral fertilization on the yield and elemental composition of tomato plant.....	23
3.2. Second experiment: Effect of soil moisture depletion, irrigation method and organic manure on the yield and nutritional status of tomato plant	24
3.3. Third experiment: Effect of soil moisture depletion, type of irrigation water and sewage sludge on the yield and elemental composition of barley plants.....	26
3.4. Methods of soil and plant analysis	27
3.4.1. Soil analysis	27
3.4.2. Plant analysis	28
4. RESULTS AND DISCUSSION	29
4.1. Effect of soil moisture depletion, irrigation method and mineral fertilization on dry matter yield of tomato plant	29

CONTENTS (Cont.)

	Page
4.2. Effect of soil moisture depletion, irrigation method and mineral fertilization on elemental composition of tomato plant	37
4.2.1. Nitrogen concentration and uptake	37
4.2.1.1. Nitrogen concentration in tomato shoots	37
4.2.1.2. Nitrogen uptake by tomato shoots.....	39
4.2.1.3. Nitrogen concentration and uptake in tomato fruits	43
4.2.2. Phosphorus concentration and uptake	45
4.2.2.1. Phosphorus concentration in tomato shoots	45
4.2.2.2. Phosphorus uptake by tomato shoots.....	47
4.2.2.3. Phosphorus concentration and uptake in tomato fruits	50
4.2.3. Potassium concentration and uptake	52
4.2.3.1. Potassium concentration in tomato shoots.....	52
4.2.3.2. Potassium uptake by tomato shoots.....	55
4.2.3.3. Potassium concentration and uptake in tomato fruits	56
4.2.4. Iron concentration and uptake	59
4.2.4.1. Iron concentration in tomato shoots	59
4.2.4.2. Iron uptake by tomato shoots.....	62
4.2.4.3. Iron concentration and uptake in tomato fruits	66
4.2.5. Manganese concentration and uptake	68
4.2.5.1. Manganese concentration in tomato shoots.....	68
4.2.5.2. Manganese uptake by tomato shoots.....	70
4.2.5.3. Manganese concentration and uptake in tomato fruits	71
4.2.6. Zinc concentration and uptake	73
4.2.6.1. Zinc concentration in tomato shoots.....	73
4.2.6.2. Zinc uptake by tomato shoots.....	75