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SOIL MOISTURE CHARACTERISTICS OF SOME SOILS IN KALIOBIA GOVERNORATE

BY

KHAIRY ABD EL-HASEEB KHALIL

B.Sc. (Soils), Cairo University, 1970

M.Sc. (Soils), Al-Azhar University, 1979

THESIS

Submitted in Partial Fulfilment of the

Requirement for the Degree of

DOCTOR OF PHILOSOPHY

IN

Soil Science

Department of Soils and Agricultural Chemistry

Faculty of Agriculture, Moshtohor,

Zagazig University

Benha Branch

الله

بسم الله الرحمن الرحيم

قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ .

صدق الله العظيم

البقرة - ٣٢ -

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This thesis has been approved by:

Prof. Dr....Bayoumi.....N..A.......

Prof. Dr...M..Gouda..................

Prof. Dr....F..M....Halil..........

Prof. Dr.....S...Abdelkader

(Committee in charge)

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CONTENTS

1. INTRODUCTION

To serve as a favorable medium for plant growth ; the soil must store and supply water and nutrients . The soil - water - plant system is further complicated by the facts that plant roots must respire constantly and that most terrestrial plants cannot transfer oxygen from their aerial parts to their roots at a rate sufficient to provide for root respiration . Hence the soil itself must be well aerated , by the continuous exchange of oxygen and carbon dioxide between the air-filled pores and the external atmosphere . An excessively wet soil will stifle roots just surly as an excessively dry soil will desiccate them .

The variable amount of water contained in a unit mass or volume of soil , and the energy state of water in the soil are important factors affecting the growth of plants . Numerous other soil properties depend very strongly upon water content, included among these are mechanical properties. Soil water content governs the air content and gas exchange of the soil. Thus affecting the respiration of roots , the activity of microorganisms , and the physicochemical state of the soil (e.g., oxidation-reduction potential) .

The per mass or per volume fraction of water in the soil can be characterized , in terms of soil wetness . The physicochemical condition or state of soil water is characterized in terms of its free energy per unit mass , termed, the potential . Of the various components of this potential , it is the pressure or matric potential which characterizes the tenacity with which soil water is held by the soil matrix . Wetnes and matric potential are functionally related to each other , and the graphical representation of this relationship is termed the moisture characteristic curves .

The hydraulic conductivity (saturated , unsaturated) and the soil water characteristic are important factors in describing soil water movement . Knowledge of these properties is mostly cumbersome to obtain because most measurements are laborious tedious , and restricted to a limited measurement range . To evade the difficulty of directly measuring these hydraulic properties , soil physicists have shown a continuos interest in generating these properties from more easily determinable soil properties .

In this work, an attempt is made to throw a considerable light on the moisture characterstics of some Egyptian soils represented by the main geomorphological units, i.e.,natural levee, sedimentary basin, river terrace overlapping, and saline soils. Also, prediction equations are estimated and applied to describe the soil hydraulic properties, i.e., moisture characteristic curves, and unsaturated hydraulic conductivity.

2. REVIEW OF LITERATURE

2.1 Soil Moisture Characteristic Curves:

The soil moisture characteristic, i.e., the soil water content-matric potential relationship, is one of the basic hydraulic properties of the soil.

The shape of soil moisture retention curves depends on some properties of the soil as texture; structure; cation exchange capacity; organic matter content; and exchangeable cations.

Several investigators have developed relationships between water retained at matric potential values of 0;1,3;10,30,100,500, and 1500 K Pa and different physico-chemical properties.

In the light textured soils, the majority of soil water was released at relatively low tension, i.e.,0.4 bar, whereas in heavey textured ones only about 20% of water was released at the same tension (***EL-Kommos*, *1983)***. The effect of soil texture is mainly related to the specific surface of the particles which affects the adhesion force between the surfaces, therefore this effect appears within higher tensions. On the other hand, the ammount of soil water retained at a relatively low values of tensions depends mainly on the capillary effect and the pore-size distribution ***(Hillel, 1971 and Talha, et al., 1978)***.

Similar results have been recorded by ***Sabrah (1982)*** who found that the drying curves of sandy and sandy loam soils showed sharp decrease in moisture content at lower suction, whereas the loamy and clayey soils showed smooth curves with regular and gradual decrease in moisture released under the same applied suctions.

Additionally, the effect of particle size distribution on the moisture characteristic curves have been studied by several investigators. ***Sabrah, 1982; Gupta, et al., 1983; Mathew and Nair (1985); Zhang and Miao, 1985, Huston, 1986; and Arruda, et al., 1987*** found positive relationships between soil water retention and clay , silt , and silt +clay content . On the other hand , a negative correlation was achieved with sand fraction .

Das and Gupta (1987) studied the relation between soil moisture retention and water stable aggregates , the release of moisture at lower tensions (0.33 bar) was mainly governed by inter-aggregate pore size distribution , whereas at the higher tension the release of moisture was governed by intra-aggregate pore size distribution .

The soil water retention in relation to soil compaction has been studied by several investigators . ***Freire and Scardua (1978)*** reported that the soil water retention (in the range of 0.001 to 15 bar) decreased with soil depth . In contrsat , ***Choudhury and Millar (1983)*** showed that the soil water holding capacity , within the same tensions , increased as the soil depth increased .

A positive relation was attained between both soil water retention and organic matter content ***(Gupta , et al ., 1983 ; Prameela and Nair , 1985).***

Fikry (1966) Found that in sandy soils the increasing amount of calcium carbonate had a small noticeable effect on the water characteristics depending upon its precentage in fine fraction (silt + clay) . Whereas a negative relation was attained between water retention and carbonate content, the opposite trend , i.e., a positive relation with CEC; exchangeable sodium and magnesium were achieved ***(Subbaiah and Manickam, 1986)***.