

**SALT AND WATER MOVEMENTS AS
AFFECTED BY DIFFERENT SOIL
MOISTURE CONTENTS IN SOME
EGYPTIAN SOILS**

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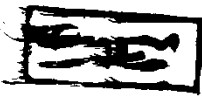
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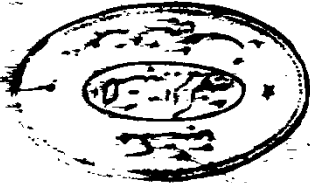
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1 . I N T R O D U C T I O N .

or indirectly related to soil water, since the soluble salt-affected soils. Soil irrigation process is directly agent, plays a decisive role in the development of water, as reactant, solvent and transporting

same as in the A.R.E. used for irrigation, especially in arid regions, the water acts as a pioneer source of soluble salts when in areas that receive salts from different resources. being salt-affected soils. Saline soils usually occur and semi-arid regions are generally characterized by and are often in a delicate environmental balance. Arid regions - particularly soil and water - are limited, The natural resources of arid and semi-arid

more food. areas to relieve population pressures and to provide therefore, is increasingly turning to the deteriorated loped land has already been exploited. Attention, and may double again in the next 30 years. Easily dev- ulation has increased four times in the past 150 years classified as arid or semi-arid. The world's total pop- One third of the world's land surface has been

1. INTRODUCTION.

Water movement can be considered as the only effective agent by which salts move through the soil. The movement of water, however, is relatively complex because of the various directions and strata in which it moves, and these various forces operate to direct its movement. Thus, salts movement and distribution in the soil are affected by all factors affecting water movement. On the other hand, salts move from the layer of high salt concentration to the layers of low concentration, which explains why the direction of salt

salts move with the water and according to the solid-liquid interface phenomena. The chemical characteristics of the soil solutions govern the ion composition of the soil adsorption complex and properties of solid soil constituents. This influences the rate of hydration and dispersion, swelling-shrinkage phenomena, arrangement of primary particle shape, size and stability of soil micro and macro-aggregates, structural elements, consequently, the pore size distribution, factors of soil moisture regime, spatial and time distribution of moisture content, moisture potential and moisture movement.

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movement may be opposite to the direction of moisture flow (diffusion movement). So, the simultaneous transport of salt and water is an important phenomenon, which deserves investigation. Sometimes, soil profile has different layers, so the effect of soil stratification on salt and water movement and distribution must be taken into consideration.

Large area in the north part of the Nile Delta suffers from salinization problem besides the north coast zone in A.R.E. Salt accumulation is governed, to a great extent, by soil properties, location and the climate of the zone which is also affected by water movement.

The aim of this investigation is the study of salt and water movement in some Egyptian soils as affected by different initial soil moisture contents, soil textures and stratification.

2. REVIEW OF LITERATURE.

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The theory of moisture transport in soil has been the subject of numbers of review and books, (Childs, 1967; 1969; Klute, 1969; Bear, 1970; Hillel, 1970; Philip, 1970; Baver et al. 1972, 1976; Hillel, 1980, 1982). The movement of water in a porous medium such as soil may be analyzed utilizing the continuous medium approach in which, the various relevant physical properties (densities, velocities, ...etc.) are considered to be continuous of position and time.

2.1.1. Soil water flow concept.

Several aspects of water movement in soils are important. These include the infiltration of water and saturated and unsaturated flow through the soil. Unsaturated flow is particularly important in terms of water supply to roots. Under some conditions, movement in the form of vapor is of importance, Kramer (1983). Generally, water in the liquid phase moves under potential gradient effect. Water flow takes place in the direction of decreasing potential, Kramer (1983).

2.1. Movement of soil water.

2. REVIEW OF LITERATURE.

A. Saturated flow.

Saturated flow in soils occurs when all or most of the pores are completely filled with water. The rate of saturated flow can be stated in two equations. The first equation is the equation of Poiseuille which expresses the flow of water in a narrow tube.

$$Q = \frac{P \cdot \pi \cdot R^4}{8 \cdot L \cdot Z}, \text{ where:}$$

Q = volume of flow, cm³/Sec.

P = pressure difference, dyne/cm²

R = radius of tube, cm.

L = length of tube, cm.

Z = viscosity of liquid, dyne-sec/cm².

This equation shows that the pore size is of outstanding importance as its fourth power is proportional to

the rate of saturated flow. This indicates that, saturated flow under, otherwise, identical conditions decreases as the pore size decreases. In fact, flow through deflocculated clay is practically zero. The occurrence of viscosity in Poiseuille equation indicates the effect

of temperature on saturated flow. Viscosity of water increases more than one percent with each degree centigrade drop in temperature.

The second equation is the equation of Darcy, (1956) which states that the viscosity of liquid flow through a porous medium is proportional to the force causing the flow, the hydraulic conductivity of the medium, and to the pressure gradient as a driving force as follows.

$$Q = \frac{C \cdot K \cdot A \cdot P}{L} \quad , \quad \text{where;}$$

Q = flow velocity, L^3/T .

C = dimensionless proportionality constant

K = hydraulic conductivity, $L^3 \cdot T/M$

A = cross-sectional area of porous media L^2

P = pressure gradient $M/L \cdot T^2$

L = length of porous media, L .

If the hydraulic head gradient is considered as a driving force, the equation will then become;

$$V = K \cdot I \quad , \quad \text{where;}$$

$D(\theta) = \text{the diffusivity, cm}^2/\text{day}.$

$K(\theta) = \text{unsaturated hydraulic conductivity}$

$z = \text{the depth measured positively downwards, cm.}$

$t = \text{time, day}$

$\theta = \text{moisture content on volume basis, cm}^3/\text{cm}^3.$

where;

$$\frac{\partial \theta}{\partial t} = \frac{\partial}{\partial z} \left[D(\theta) \frac{\partial \theta}{\partial z} \right] + \frac{\partial}{\partial t} \left[K(\theta) \frac{\partial \theta}{\partial z} \right]$$

tion can be written according to Klute, (1973) as follows:-

The water flow equation for unsaturated condi-

under the influence of a tension gradient.

by the soil, the slower is the ability of water to move rated flow, Kohnke, (1968). The lighter the water is held tion and change has much to do with the rate of unsatu- ted flow no air-water interface exists, meniscus forma- sion with which the soil water is held, while inatura- The rate of unsaturated flow depends on the ten-

B. Unsaturated flow.

$i = \text{hydraulic-head gradient ratio.}$

$K = \text{hydraulic conductivity, l/T}$

$V = \text{flow rate, l/T}$