MATHEMATICAL MODEL BY PREDICTING THE DISTRIBUTION OF SOIL MOISTURE IN THE ROOT ZONE OF TURF LANDSCAPE

By

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B.Sc. Agric. Eng., Faculty of Agric., Ain Shams University, 2014

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ABSTRACT

Shahenda yehia Ebrahim Ali El Basha: Mathematical Model By Predicting the Distribution of Soil Moisture in the Root Zone of Turf Landscape. Unpublished M.Sc. thesis, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University, 2019.

A laboratory experiment was conducted to study the irrigation interval day around effective root zone for turf, used three treatments (spray, SDI and hydrogel) by measuring the moisture content every day in soil and then determine irrigation interval time for every irrigation treatment.

The Field experimental was carried out in Faculty of Agriculture, Ain Shams University, Kalubia Governorate , Egypt , Throughout the period from 21/10/2016 to 20/10/2017 (12 months), to construct mathematical model by predicting the distribution of soil moisture content in the root zone of turf landscape .

Experimental area of 182.25m^2 divided into 9 plots (4.5*4.5m) for three irrigation treatments ((spray type (nozzles 15) under pressure 2 bar, with discharge 0.8 m^3/ hr, SDI (Type of emitters used (built-in) with discharge of 2L/h at 1.0 bar operating pressure) and hydrogel where it is a unique material in terms of its ability to absorb water) . Each treatment replicated three times , The plants used was one of the landscape plants (passpalm 10) at the landscape area and it was new rolls and the roots were short.

Results of laboratory experiment could be summarized as follows:

- Through the laboratory experiment, the distance between the irrigation was calculated under three treatments (spray – SDI – hydrogel).
- Period between irrigation under spray irrigation was daily for a quarter of an hour and under the SDI irrigation was daily for half an hour , while under the hydrogel treatment was done every four

days because the wilt point of soil was 9% , field capacity of soil was 22% .

- Results of Field experimental could be summarized as follows:
- Annual water consumption less by 77.3%, 71.3% when using hydrogel , compared with other irrigation systems (spray, and SDI) resp. , this is due to the quantity of loss water from evaporation in spray irrigation treatment , sun exposure more than (SDI, hydrogel) irrigation treatments .
- The hydrogel treatment has highest water saving by 166% and 69% compared with (SDI and hydrogel) irrigation treatments resp., because the hydrogel's ability to hold water and a large period between irrigation when using hydrogel in the soil .
- The SDI treatment has highest electrical saving by 35.7% and 293% compared with (spray and hydrogel) irrigation treatments resp.
- The turf quality index (color , density , ground cover) give high degree at hydrogel treatment compared with other irrigation treatments (SDI , spray) , this is due to the hydrogel have many materials , both naturally occurring and synthetic and ability of water saving around root zone of turf .
- The average of soil moisture contents at (10cm,15cm) depth of soil in hydrogel treatment was highest compared with (Spray , SDI) irrigation systems resp.

Keywords: Irrigation, Spray, Hydrogel , Sub-surface drip irrigation, turf, Distribution of soil moisture.

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INTRODUCTION

Water scarcity is a growing global problem in some parts of the world , Egypt is one of those countries facing such challenges, .it receives about 98% of its fresh water from outside , the population of Egypt is the main cause of it is problem , Since 1959, Egypt's share of Nile water has been estimated at about 55.5 billion cubic meters per year , this was when the population of Egypt was about 25 million , Egypt now has three other peoples, with more than 98 million people (**National Organization for Mobilization and Statistics**)

In Egypt, there are a lot of residential compounds, touristic villages and municipalities' landscape and all of these require a big amount of irrigation water per day , the majority of these turfs are grown on highly permeable sandy soils. Careful management is therefore required to achieve an acceptable balance between maintaining turf quality, reducing water use and minimizing water and nutrient loss beyond the root zone (**Del Marco, 1990).**

Proper irrigation system selection for strips, islands, and areas near buildings, sidewalk, and steep areas is very important to obtain good turf quality, minimum operation ,costs and water losses **(Bedair , 2018).**

R. Kjlgren et al (2000) stated that , with increasing seasonal water use most of them goes to landscape , because the high water requirement , increasing use of irrigation for landscape is causing new demands for efficient irrigation systems .

There is a problem of loss of water due to the use of uni-spray in the turf areas, where this loss is in several forms: evaporation of water from the surface, the volatilization of water droplets with the change of the prevailing weather, the emergence of some salts on the surface of the soil requiring an additional amount of water to wash these salts and covers Small spaces require more sprinklers , **(Irrisoft, 2014).**

INTRODUCTION

Toro solutions (2006) reported that narrow or irregularly shaped areas, including turf , less than 8 feet in width in any direction, shall be irrigated with sub-surface drip irrigation or low volume water irrigation system , sub-surface drip irrigation saves water with minimal water loss due to mist, evaporation, runoff or wind drift , There have been some investigations of the viability of using sub-surface drip irrigation (SDI) to irrigate turf grass(**Johnson and Leinauer, 2004; Devitt and Miller, 1988 and Ferguson, 1994**), some of the benefits of SDI over conventional irrigation are that it operates at lower volumes and flow rates, puts water directly into the root zone, and is thus less susceptible to lessees from wind and evapotranspiration.

The use of hydrogel down the root zone to turf a good irrigation method to provide water and at the same time give the plant its need without waste , Where it is a unique material in terms of its ability to absorb water and its resistance to degradation, They are gelatin placed under the surface at specific distances that absorb water quickly and retain large amounts of it. It shows the ability to inflation and retain a large part of the water inside its structure, but it will not dissolve in the water. It is a super absorbent where it forms a group of polymeric materials, Keep large amounts of water in their 3D networks .

El-Gindy et al. (2001), mentioned that, sandy soil has low holding capacity, so using soil conditioners especially polymers can increase the water holding capacity of the soil. The use of polymer is not restricted to only sandy soils but also to clay soils however it can improve soil hydraulic conductivity, seed emergence and eliminate crust problems. They also reported that incorporated polymer into the soil will improve soil structure and water retention, thus reducing leaching, reducing water losses due to percolation and evaporation, protecting the plant against water stress and increasing both the nutrient and water supply to the roots.

Objectives of this study are:

1- Predicting the distribution of moisture levels below the root zone turf area as a result of the addition of hydrogel .

2- Determine the best application rates of water for hydrogel treatment compared with using different irrigation system (spray and SDI) treatments .

3- Determine the best quality index (color – density – ground cover%) under three treatments (hydrogel – SDI – Spray) irrigation systems .