A COMPARATIVE STUDY OF CONVENTIONAL AND MODERN PALM IRRIGATION SYSTEMS IN NEWLY RECLAIMED LANDS

By

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ABSTRACT

Salwa Besher Mohamed Mazen. A Comparative Study of Conventional and Modern Palm Irrigation Systems in Newly Reclaimed Lands. Unpublished Ph.D. Thesis, Agricultural Engineering Department, Faculty of Agriculture, Ain Shams University, 2019.

A field experiment was conducted in newly reclaimed sand soil to find out the most efficient combination between irrigation system and deficit irrigation management can be used for date palm trees "*Zaghlol cultivar"*.

Results revealed that the average water requirements of date palm trees gradually increased from 1504, 1279, 1128 and 978 for drip to 2522, 2143, 1891, and 1639 m^3/fed-Season for bubbler irrigation system in combination with 100, 85, 75 and 65% deficit irrigation treatments respectively. Similar trend was also observed comparing with flood irrigation system with 100 % irrigation deficit treatment where the water requirements increased from 1504 for drip and 2522 for bubbler to 4083 m^3/fed-Season for flood irrigation system. Data indicated that $EC_{1:5}$ in dS/m gradually increased with decreasing deficit irrigation levels from 100 to 65% and with increasing soil layer depth to 60-90 cm either in parallel or perpendicular direction of drip or bubbler irrigation lines. While opposite results were observed for soil moisture distribution. Results showed an evident decrease in crop yield as affected by water stress associated with decreasing deficit irrigation treatments from 100 to 85, 75 and 65 % by about 167, 155, 153, 151 for drip and 181.5, 168, 172 and 169 kg/Tree for bubbler irrigation systems. Data revealed that water use efficiency increased from 9.55 for 100% DI to 10.4, 11.7 and 13.2 for drip and from 6.19 for 100% DI to 6.74, 7.82 and 8.87 for bubbler irrigation systems with decreasing deficit irrigation levels to 85, 75 and 65% respectively. From the above mentioned results, it could be concluded that the best method for managing irrigation of date palm trees "Zaghloul cultivar" in the study area is irrigation using bubbler system with 75% sustained deficit irrigation. This combination treatment gave an acceptable yield about 172 kg/tree using about

1891 m^3 irrigation water per feddan or 22 m^3/tree-season and saving a substantial amount of irrigation water reached to about 25 % leading to an encouraging value of water use efficiency by date palm trees about 7.82 kg/m^3.

Key words: Drip and bubbler Irrigation, Water use efficiency, Deficit irrigation, Date palm.

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INTRODUCTION

Water shortage is an increasingly important issue in many parts of the world. This is especially the case in Arid Regions of Arab countries to frequent droughts and where restricted supply of good quality water is the most important factor limiting crop production. Most of the Arab countries are located in arid and Semi-Arid zones known for their scanty annual rainfall, very high rates of evaporation and consequently extremely insufficient renewable water resources **(Aqeil, et al., 2012)**.

Water use efficiency needs to be improved by searching for different strategies of deficit irrigation. In this context, the response of date palm to these strategies was evaluated by the experimental study of the effects on the vegetative growth of mature palms

In spite of the problem of water shortage in arid regions which is becoming more serious with time **(Zakaria, et al., 2012)**, the farmers in these regions had yet used unconventional techniques to increase water resources to overcome this problem. Insufficient water supply for irrigation will be the norm rather than the exception, and irrigation management will shift from emphasizing production per unit area towards maximizing the production per unit of water consumed **(Fereres and Soriano, 2007).**

In Egypt, where water is scarce**,** trickle irrigation becomes an attractive alternative for conserving water **(EI-Awady et al., 2008)**. With the trickle irrigation systems, water and nutrients can be applied directly to the crop at the root level, having positive effects on yield and water savings and increasing the irrigation performance **(Simonne et al., 2012).**

Full irrigation is the way of applying the amount of water to a crop equal to that removed from the field by evapotranspiration throughout the growing season. Full irrigation is considered a luxury use of water that can be reduced with minor or no effect on profitable yield **(Kang and Zhang, 2004).**

INTRODUCTION

Fereres and Soriano, (2007) reported that it is a must to optimize water use in order to maximize crop yields under water deficit conditions. One of the means to improve water use efficiency is deficit irrigation **(Topcu et al., 2007)**. Deficit irrigation has been practiced in different parts of the world **(Oktem et al., 2003; Karam et al., 2005** and **Ali et al., 2007).**

Hull (1981) reported effective use of bubbler irrigation system in orchard fruits trees, other researchers continued the work of improving system design that can be adopted under different aspects like as areas, weather climate, soil condition and water flow rate/ discharge on fruit trees.

In some developing countries, high efficiency micro irrigation methods, such as trickle/drip, bubbler and sprinkler irrigation are now in practice, which save the water and produce high yields **(Dagdelen, 2009)**.

Date palm is playing an effective role in the Egyptian agriculture and represents a substantial part in the reclamation program. Moreover the nutritional values and health benefits of the fruits, the date palm by-products are regularly used by Egyptians. Adaptation of date palm trees to water stress made it as one of the most important fruit trees distribution in arid and semi-arid regions of Egypt **(Riad, 1993)**.

Date palm trees are grown all-over Egyptian lands. In addition, date palm trees considered the most successful fruit tree grown in the new reclaimed areas such as Toshki, El-Ewinates and Sinai areas. The total number of date palm trees planted in Egypt is about 16 million, 75% of these trees are in fruiting stage **(FAO-STAT, 2009)**. According to **(Hassan and Abuarab, 2013)** it is feasible to save water with improving its water use efficiency by date palm trees to achieve adequate fruit yield.

The main objective of this work is to find out the most efficient combination between irrigation systems and deficit irrigation management can be used for date palm trees grown on sand soil in newly

reclaimed areas under arid land conditions according to its effects on crop yield, water use efficiency and the regularity of water and salt distribution in root zone.

REVIEW OF LITERATURE

2.1. Water shortage in Arab Region

IPCC (2007) expected an increase in temperature in the Arab region of up to 2°C by 2030 and 4°C by 2100, with a reduction of water run-off with about 20-30% by 2050, this mainly due to increasing temperatures with less precipitation which may led to high possibility of more frequent droughts**.** Water demand for irrigation may increase as evapotranspiration increases due to higher temperatures.

Also, according to **Perry et al., (2009)** as a consequence of climate change, some areas will receive higher rainfall but most of the currently water-scarce regions will become drier and warmer.

Water availability is generally the most important natural factor limiting the widespread and development of agriculture in arid and semi-arid regions. Most of the Arab countries are located in arid and semi-arid regions known for their scarce annual rainfall, very high rates of evapotranspiration and accordingly extremely insufficient renewable water resources **(Bozkurt and Mansuroglu, 2011)**.

Agricultural land had been reduced drastically due to water scarcity, despite this fact; none of the farmers had yet used non-conventional techniques to increase water resources to overcome water shortage problems. Egypt depends mainly on River Nile to provide high percentage of agricultural water use for thousands years. At last years, Egypt is suffering from shortage in water resources due to global climate changes and unfair water politics of the neighboring countries such as the Ethiopian Eland Dam, which will affect the future of agriculture plans for irrigation. In addition the lack of developed systems of water management in the irrigation projects and improper allocation of irrigation water, which reduces water use efficiency and lead to losing irrigation water and decreasing in agricultural yield **(Al-haddad and Al-Safi, 2015).**

Al-Mansor (2015) concluded that under conditions of water shortage, especially in the Arab region, which suffers from water scarcity, subsurface trickle irrigation technologies in combination with deficit irrigation strategies can be used to improve irrigation water use efficiency and the yield under open field conditions.

The request for irrigation water in 2025 will rise in all the Arab countries and that will create a problem in distribution of water resources between different sectors. These reflect a threatening situation for water and food security in the Arab World during the current century **(Ouda et al., 2011).**

Awad et al (2016) conducted a field experiment to study the effect of water managements and crop coefficient of date palm trees on some growth parameters, yield and irrigation water use (IWU) of Barhee date palm cultivars in a newly established orchard. Four water treatments, i.e. 70, 85, 100 and 115% of water requirement were studied to find out the most efficient water regime in maximizing yield and IWU. The highest yield was obtained from 115% (16.5 kg/tree), and the least from 70% (12.4 kg per tree). IWU is increased by decreasing the water regime. He concluded that increasing water supply maximizes yield production of young Barhee date palms in a newly established orchard.

2.2. Effect of Irrigation Method on Water Saving

In some developing countries, high efficiency micro irrigation methods, such as trickle/drip, bubbler and sprinkler irrigation are now in practice efficient methods to save the irrigation water and produce high yields. These methods have advantages and disadvantages as one method may be suitable for a set of conditions but inappropriate for other **set (Dandelion *et al.* 2009)**.

Tagar *et al.* (2012) compared drip and furrow irrigation methods in a field study conducted at a farmer's field and observed 56.4% in water saving with drip irrigation. While **Alihouri and Torahi (2013)** shown