Advances in Bioresearch
Adv. Biores., Vol 7 (3) May 2016: 82-89

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
ICV Value 8.21 [2014]

Advances in Bioresearch

ORIGINAL ARTICLE

Impact of Conventional and Modified Subsurface Drip Irrigation Systems on Water Distribution through the Soil Profile

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ABSTRACT
Water in Saudi Arabia, despite its environmental and climatic arid conditions, is the key factor in the development processes. Therefore the main objective of this research is to study the feasibility of saving water through the use of capillary irrigation with special emphasis on studying the distribution pattern of soil moisture content in the soil under subsurface irrigation systems. Experiments were conducted in the educational farm of the College of Food and Agriculture Sciences, King Saud University. Experiments were designed for two levels of irrigation based on the application time: (i) 4 l/h for two hours (Level1), and (ii) 4 l/h for one hour (Level2). Three drip irrigation systems were investigated in this study: (i) surface drip irrigation (SDI), (ii) conventional subsurface irrigation system (SIS), and (iii) modified Kapillary irrigation subsurface system (KISSS). Both SIS and KISSS laterals were installed at a soil depth of 25 cm. Soil moisture measurements were carried out in a grid form: vertically at four soil depths from the laterals and horizontally at four distances from the emitters. Soil moisture values were used for the generation of wetting patterns through the soil profile. The results indicated that the SIS maintained same amount of water in the top soil layer as the SDI, but it was associated with the highest amount of water losses through deep percolation. The KISSS showed significant improvement in the performance of subsurface irrigation in terms of high water content in the top soil layer and less water losses through deep percolation.
Keywords; *Drip irrigation, Subsurface irrigation, Capillary irrigation, Wetting patterns*

Received 08/12/2015 Accepted 22/01/2016

How to cite this article:
Abbas M. E., Al-Ghobari H., Tola E., Al-Gaadi K. A. Impact of Conventional and Modified Subsurface Drip Irrigation Systems on Water Distribution through the Soil Profile. Adv. Biores. Vol 7 [3] May 2016: 82-89. DOI: 10.15515/abr.0976-4585.7.3.8289

INTRODUCTION

Global use of water in the agricultural sector is estimated at about 80% of the total available quantity, while in Saudi Arabia it was estimated at about 90% [1]. Climate changes constitute additional factors leading to the worsening of the situation in terms of future sharp decline of water and increase in temperatures, which then lead to increase in drought and consequently to the increase in crop water requirement and the result will be high deficit between supply and demand of water [2, 3]. The Kingdom of Saudi Arabia suffers from the harsh climatic conditions that significantly reduce the efficiency of agricultural production. Climatic conditions in the Kingdom of Saudi Arabia are characterized by a very low amount of annual rainfall ranging between 80 and 140 mm, extreme temperatures (especially in summer) often exceeded 45 °C and a very low relative humidity [4].

The efficient use of amounts of water available to the agricultural sector can be attained through the implementation of a well planned irrigation systems and the use of modern irrigation techniques such as sprinkler and drip irrigation technologies. Drip irrigation, also known as trickle irrigation or microirrigation, is the application of water to the soil surface (surface drip irrigation - SDI) or directly to the plant root zone (subsurface drip irrigation "or subsurface irrigation system" - SIS) as drops or tiny streams; through a network of valves, laterals, tubes and emitters [5, 6].