DRIP IRRIGATION SYSTEM MANAGEMENT UNDER SALINITY CONDITIONS IN SANDY SOIL USING NUCLEAR TECHNIQUES

By

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ABSTRACT

Shaimaa Khaled Emam EL-Tohory: Drip Irrigation System Management under Salinity Conditions in Sandy Soil Using Nuclear Techniques. Unpublished M.Sc. Thesis, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University, 2016.

A field experiment was carried out at the experimental farm of Nuclear Research Center in sandy soil with and without rice straw mulching under drip irrigation system during 2014/2015 winter season in Egypt to evaluate the effects of soil mulching and irrigation water salinity on improving the yield and water-use efficiency of wheat crop (*Triticum aestivum* L.) cv Masr 2 variety. Consequently, combating salinity stress via soil mulching was studied. Treatments of water salinity, i.e. fresh water (0.5 ds m^{-1}), (6 dS m^{-1}) and (8 dS m^{-1}) were applied twice a weekly using a total amount of 440 mm during the growing cycle with and without rice straw mulching. Wheat irrigated with fresh water under non-mulching conditions resulted in higher yield (9.43 ardab fed^{-1} equal to 3366 $kg.ha^{-1}$) than those of mulched one (9.04 ardab fed^{-1} equal to 3227 kg ha^{-1}). Similarly, it was higher than those recorded with both water salinity levels. This holds true with either mulched or non-mulched plants. Under saline irrigation of 6 and 8 dS m^{-1}, wheat yield and water use efficiency of mulched treatments was higher than the non-mulched ones. Nitrogen uptake by grain of wheat irrigated with fresh water under non-mulching treatments was much better than those of mulching treatments. Mulching treatments irrigated with 6 and 8 dS m^{-1} were much better than non-mulched one. Nitrogen uptake by shoots in mulching treatments was much better than in non-mulching treatments. Nitrogen derived from fertilizer by grains was higher than those of shoot. It severely reduced by increasing water salinity levels as compared to fresh water treatment. Mulching treatment has a positive effect on combating salinity stress and in the same time improved the NUE comparing to the un-mulched soil.

Keywords:

Drip irrigation, Mulching, ^{15}N application, Neutron scattering, Salinity management, Wheat.

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INTRODUCTION

Water scarcity is considered one of the most pressing issues of the 21st century, particularly in arid regions of the world, where it has developed into a major threat to food security, human health, and natural ecosystems. The challenges of growing water scarcity are augmented by over-exploitation of existing resources, soil and water pollution, and the increasing costs of developing new water supplies, burdened by subsidies and distorted incentives that influence water use. More recently, climate change has emerged as an additional potential stress on water resources in arid regions, a region that appears to be highly vulnerable to the impacts of climate change. The latter is projected to increase the extent of drought-affected areas, with the potential for adverse impacts on various sectors (i.e. agriculture, water supply, energy production and health) with up to 3.2 billion people at risk of experiencing increased water stress by 2080 **(El-Fadel and Maroun, 2009)**.

Water resources in Egypt becoming scarce. Surface-water resources originating from the Nile are currently fully exploited, while groundwater sources are being brought into full production. Egypt is facing increasing water needs, demanded by rapidly growing population, increased urbanization, higher standards of living and by an agricultural policy which emphasizes expanding production in order to feed the growing population. The population is currently increasing by more than one million persons a year. Egypt is expected to see an increase to some 100 million people by 2025. The most critical constraint facing Egypt is the growing shortage of water resources accompanied by the deterioration of water quality **(Abdin and Gaafar, 2009).**

Wheat (*Triticum aestivum L.*) is one of the most important cereal crops in the world as well as in Egypt. Wheat represents the main food for more than one third of the world population; in Egypt wheat provides 37% of the total calories for the people and 40% of the protein in the Egyptian diet. Also, it is a major source of straw for animal feeding **(Badr *et al.*, 2015).**

Irrigated agriculture with saline water cannot be sustained without adequate leaching and certain management practices to prevent excessive salinization of the soil. Appropriate using of saline water for producing stratigical crop such as wheat can help to diminish food gab and increase food security management of saline water. However, we have to search for ways and means for using such water resources successfully in irrigation without adverse impacts on soil productivity, crop production and the environment **(Hamdy, 1997).**

The accumulation of salts in surface soil layers can be managed by reducing evaporation from the soil surface **(Bezborodova *et al.*, 2010).** Mulching can be an effective technique to reduce soil evaporation **(Zribi *et al.*, 2015),** To achieve both water and food security we have to find alternative strategies. One of the options is to increase the use of marginal quality water for irrigation to face challenges. There is usually no single method to achieve safe use of saline water in irrigation. Many different approaches and practices can be combined into satisfactory saline water irrigation systems **(Yazar *et al.*, 2015).**

The aim of study:-

- Studying the effect of saline water on wheat productivity in sandy soil under drip irrigation system.
- Evaluating the effect of using rice straw mulching as a strategy on water use efficiency.
- Studying the effect of rice straw mulching and irrigation water salinity on nitrogen use efficiency and nitrogen uptake using ^{15}N tracer technique.

REVIEW OF LITERATURE

2.1. Water Scarcity in Egypt:

In Egypt water and land are the main natural resources that Egypt relies up on. As far as water concerned the River Nile supplies Egypt with represents about 55.5 billion cubic meters annually. The agricultural area represents 5% of the total area of Egypt's land. Plants do exist for increasing this area which is estimated to be slightly more than 7 million feddans (one feddan= 4200m^2). Land does not represent at present a constraint for horizontal expansion; it is rather the water that is the critical parameter. Therefore, the Egyptian government has some programs and policies for large scale use of ground water, non-conventional water resources, drainage water and treated waste water. About 9 billion cubic meters annually of agriculture drainage water is planned to be reused for irrigation **(Saad *et al.*, 2015).**

2.2. Potential Needs for Non-conventional Water Resources:

Hamdy, (2005a) reported that in the agricultural sector, the use of non-conventional water resources as an additional source for irrigation is one of the practical solutions to be recommended. Its use is nowadays a must in the arid and semiarid countries in the region to satisfy the increasingly water demand in irrigation. Soil salinity is a major problem in many developing countries, The problem is particularly severe where soils are irrigated with poor-quality water and becomes exacerbated in arid climates, the accumulation of soluble salts in the soil can have a detrimental effect on crop production, The best way of dealing with the problem of excessive amounts of salts is to prevent it from happening in the first place - for example, through improved water management used in combination with appropriate crop management practices **(Acevedo *et al.*, 1999).**

2.3. Drip Irrigation Management and Soil Salinity:

Skaggs *et al.*, (2010) concluded that the drip irrigation is more effective and less expensive if a large amount of soil can be wetted with each emitter without losing water or nutrients below the root zone.

Minhas and Tyagi (1998) explained that the use of irrigation waters through drip system has revolutionized the Production of some high value crops where especially when losing saline waters. But the system has a great potential in the arid and semiarid regions particularly for the light textured soils. As regular and frequent water supply is possible with drip system of irrigating crops, it has been observed to enhance the threshold limits of their salt tolerance by modifying the patterns of salt distribution and maintenance of constantly higher matric potentials. Due to enhanced leaching and accumulation of salts at the wetting front and the soil between the drip laterals, the salt accumulation below the drippers remain very low whereas the water contents are maintained at higher levels at the latter sites. , most roots are found below the surface drippers. Hence the drip system seems to be the best method of saline water application as it avoids leaf injury to plants as with sprinklers and maintains optimum conditions for water uptake by plant roots.

Technical Hand Book (**2001**) explained that the drip irrigation system can supply water frequently; the irrigation regime leaves a zone of wetted soil with a lowered salt content, which is beneficial for root activity. Furthermore, applying water directly on the soil surface eliminates the opportunity for salts to be absorbed through the leaves, as may occur in sprinkler irrigation, Advantages of drip irrigation More uniform and higher crop yields , More efficient use of available water, Reduced cost for fertilizer and other chemicals, Reduced labour costs, Low energy requirement and Reduced salinity hazard.

Bryla *et al.*, (2011) determined the effects of different irrigation methods on growth and water requirements of un cropped plants during the first 2 years after planting. The plants were grown on mulched, raised beds and irrigated by sprinklers and micro-sprays, or drip irrigation at a rate of