IRRIGATION WATER MANAGEMENT VIA DETECTING ACTIVE ROOTING ZONE USING NEUTRON SCATTERING TECHNIQUE

By

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B.Sc. Agric. Sc. (Agric. engineering), Ain Shams University, 2011

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ABSTRACT

Ayat Ibrahim Gomaa: Irrigation Water Management Via Detectating Active Rooting Zone Using Neutron Scattering Technique. Unpublished M.Sc. Thesis, Department of Agriculture Engineering, Faculty of Agriculture, Ain Shams University, 2018.

The experiment was conducted at the farm of Soils and Water Research Department, Nuclear Research Center, Atomic Energy Authority, Inshas in a newly reclaimed sandy soil for winter season (2015/2016). Chickpea crop, variety (Giza 531) was selected for this experiment.

Three treatments of the water regimes (100%, 80% and 60%) were applied according to the depleted water amount from field capacity into the active root depth (ARD) through follow active root depth during the growing season by using neutron moisture meter. This method mainly depended on follow the soil moisture movement and appreciated the effort hydraulic.

Actual evapotranspiration, yield, crop water use efficiency and active root depth were measured and estimated. Results showed that increasing values of applied water increased the values of actual evapotranspiration, CWUE results showed no significant difference between the three treatments, but FWUE results showed that there was a significant difference between T_1 and $T_{2,}$ the active root depth arrived to end at a depth of 71 cm. And gave the highest value of crop water use efficiency and grain yield in the treatment of T_2 is (0.27kg / m^3 and 1218.09kg / ha), respectively.

Key words: Neutron probe, Active root depth, Trickle irrigation, Chickpea yield, Crop water use efficiency.

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INTRODUCTION

Water is the main factor for the developmenting of agriculture and agricultural crops specially under conditions of arid and semi-arid areas. Since the growth of crops and the amount of the yield of the crop affected by the amount of water found in different soil levels at the effective root zone It is highly desirable to obtain higher yield using the least possible quality of water (**Hirich *et al*., 2011).**

And therefore has to be water management to keep the water supply and improve net returns and this is done through the timing and regulating irrigation water way which gives the water needs of crops without wasting water, soil and plant nutrients and degradation of water resources and therefore has to be water management according to the following.

• According to crop needs

• In amounts that can be held in the soil and be available to crops

• At rates consistent with the intake characteristics of the soil and the erosion hazard of the site

• So that water quality is maintained or improved

Water is managed using three treatments of water by tracking the active root zone using neutron scattering technique and this technique is important in the study of the movement of water in different soil layers and estimating soil moisture for each depth and determine active root zone through which estimate the required amount of water for chickpea.

Chickpea has a deep rooting system, better suited to lighter textured sandy soils and is very tolerant to drought so it was used to keep track of the active root depth .

It is generally grown in drought prone areas, and derives most of its water requirements from residual stored soil moisture rather than from rainfall, chickpea yields tend to trail those of cereals and other legumes

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cultivated in more favorable areas **(Joshi *et al*., 2001).** The cultivated area in Egypt reached to 532 ha and 11,927,783 ha in the world which total production reached to 1137 tons in Egypt and 11,036,227 tons in the world and yield reached to 2.1372 kg/ha in Egypt and 138.79 kg/ ha in the world **(FAO Statistics, 2015).**

The aim of this study are:

1- Determine of active root depth by using nuclear technique under trickle irrigation system.
2- Saving irrigation water from loss by deep percolation.
3- Using irrigation scheduling to optimize water use efficiency and chickpea yield.

REVIEW OF LITERATURE

2.1. Crop water requirements

The water required by crops is provided in terms of its nature in the form of precipitation, but when it becomes scarce or does not conform to its distribution with its peak demand, it is then necessary to supply it artificially, by irrigation. There are many irrigation methods available, and one choice depends on factors such as availability of water, crops, soil characteristics, topography and associated costs (**Holzapfel *et al*., 2009).**

Consumptive water use (CWU) of these crops varies with species, climatic and soil conditions, and with the growth period. For pea, it amounts to between 350 and 500 mm per year **(Doorenbos and Kassam, 1979)**. For lentil, with probably the smallest water requirement of the four pulses, CWU values of 115 and 228 mm for 2 and 4 irrigations, respectively, were reported by (**Saraf and Baitha, 1985)** in north India. The CWU of faba bean is larger than those of pea, lentil and chickpea and varies considerably with locality. For example, **Krogman *et al*., 1980** found CWU to vary from 100 to 700 mm in Alberta, Canada. **Tawadros, 1982** reported values of 240 to 490 mm in Egypt. **Desta *et al*., 2015** used FAO CROPWAT 8.1 software to estimate the crop water requirement for chickpea found that the irrigation requirement of this crop for a single growing season was 436.7mm.

There are different methods for estimating crop water requirements such as Climatic-based methods methods *eg*. Penman Montheith equations and Pan based on whether parameters **(Allen *et al*., 1998)** , soil-water-plant system to estimate the soil water content such as the neutron probe and time domain reflectometry (TDR), or soil water tension in the soil by tensiometers or gypsum blocks.

2.2. Evapotranspitation

Evapotranspiration (ET) is the combination of two separate processes evaporation and plant transpiration from the soil surface.

Actual evapotranspiration (ET_a) is the main path of water loss from both plant and soil surface. The main goal of irrigation is to supply the plant with water is needed to obtain optimum yield and quality of a desired plant constituent. This is why in agricultural lands, ET_a measurement is needful for developing more efficient and sustainable water management techniques as well as for irrigation scheduling of crops **(Attarod *et al*., 2006).**

Estimation of actual evapotranspiration (ET_a) is an important part of agricultural water management in local and regional water balance studies. At the field scale, ET_a is important in irrigation planning and scheduling and is an integral part of field management decision support tools **(Salama *et al*., 2015).**

Evapotranspiration from irrigated agriculture is an important issue in arid and semi-arid regions where it has large effect on water resources depletion and water management **(Tasumi and Allen, 2007).**

Evaporation by one of the critical sinks in the water balance, of extreme importance in arid ecosystems. In arid ecosystems where vegetation is scarce and the water table low, evaporation may make up the only water sink. It is also of importance to agricultural managers, as it can have an impact on field irrigation applications**.**

The water exists in the soil as layers around soil partials. **Don Scott, 2000** reported that storage of retention of water by soils was a result of attractive force between solid (soil particles) and liquid phases (water), the relationship between the forces of attraction of water, where the first layer of water was held with great force of attraction, and the magnitude of the forces of attraction for water decreased as distance from