SIMULATION OF TOMATO CROP PRODUCTION BEHAVIOR UNDER DEFICIT IRRIGATION USING CROP MODEL

By

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B. Sc. Agric. Sc. (Agric. Engineering), Ain Shams University, 2009

M. Sc. Agric. Sc. (Agric. Engineering), Ain Shams University, 2013

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Approval Sheet

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ABSTRACT

Zeinab Mahmoud Mohamed Hendy: Simulation of Tomato Crop Production Behavior under Deficit Irrigation Using Crop Model PhD. Thesis, Department of Agricultural Engineering, Faculty of Agriculture, Ain Shams University, 2019.

Fresh water shortage is a critical problem that is continuously increasing, due to population growth, unsustainable usage of water resources, and the projected climate change. The impact of water shortage is more noticeable in arid regions and has higher impacts over remote regions and communities, especially in developing countries. Under limited and rare water resources in Egypt, deficit irrigation and good irrigation management could be an efficient solution for water shortage by getting the same amount of crop production or higher using less irrigation requirement.

The aim of this research is to study some irrigation schemes to enhance water productivity and decrease presented irrigation requirement of tomato crop and evaluate the yield response under water stress at sensitive growth stage. Using crop model program with different climate scenarios to predict production and water consumption in the future. Also, conducted the effects of water shortage upon fruit quality.

The water productivity WP results lead to that the 100% ETc for tomato fruit does not achieve the highest benefits, but it is possible to save water and maintaining high fruit quality by decreasing the ETc at the whole growing stages to (80% ETc). Indeed, it is possible to save water improving its use efficiency in processing tomato, but water should be applied to the crop throughout the whole growing season, even at a low rate (80% ETc), to achieve adequate fruit yield, minimizing fruit losses and maintaining high fruit quality levels.

Also, results show that the length of the crop growth cycle decreasing by 2050s for all irrigation treatment due to the increasing in temperature. While, the rate of maturity is relatively faster in high emission scenario (RCP8.5) as opposed to low emission scenario (RCP4.5). Furthermore, on average, the number of days between transplanting and maturity for tomatoes is expected to be reduced by about 3 –11 days by the end of 2050s, compared to reference period values.

On the other hand, the irrigation treatments seem to have higher impacts on the tomato dry yield, than temperature increase. That the tomato yield is expected to decrease under the current and future climate conditions, as a result to applying deficit irrigation applications.

Keywords: Deficit irrigation; Drip irrigation; tomato crop; AquaCrop; climate change.

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INTRODUCTION

Tomatoes are commercially important vegetable in the worldwide, with an annual production more than 120 million tons. Tomato is mainly cultivated in Egypt followed by China, United States, Turkey and India. **(FAO STAT Database, 2012).** Under limited and rare water resources in Egypt, deficit irrigation and good irrigation mangment could be an efficient solution for water shortage by getting the same amount of crop production or higher using less irrigation requirment.Tomato production arrived in Egypt to 8.5 million tons with an average productivity ranged from 30-60 ton/feddan. The total cultivation area in 2013 for tomato crop was 488753 Fadden. **(Bulletin Agriculture Statistics, 2013).**

One of the solution of this problem is to enhance water productivity and decrease present irrigation requirement of tomato crop. The deficit irrigation levels and good irrigation scheduling could improve tomato water productivity, especially when deficit levels applied at both early and late stages of crop growth stages. **(Attaher , 2012)**

AquaCrop is a new decision support tool useful in modeling and devising strategies for efficient management of crop-water productivity at farm level. To make AquaCrop globally applicable, it must be tested in different locations with different soil conditions, crops, agronomic practices and climatic conditions. **(Darko., et al., 2016)**.

AquaCrop is exclusively based on the water-driven growth module, in that transpiration is converted into biomass through water productivity parameter **(Todorovic et al., 2009).**

The main objective of this study is to investgate the possablities to improve the irrigation water productivity of one of the tomato crop. This objective coud be achived by following the three steps:

(i)Investigate the actual effect of applying different deficit irrigation schemes on the growth parameters and the yield of tomato crop.

(ii)Conduct a calibration of AquaCrop model to simulate the effect of deficit irrigation schemes on tomato crop, under the local current conditions (iii)Assess the impact of climate change on tomato crop under full irrigation and different deficit irrigation schemes.

REVIEW OF LITERATURE

2.1 Agricultural water profile of Egypt:

Water is the natural resource that exerts the greatest constraint on Egypt's agricultural production system **(Attia, 2004).** The Nile River is the main source of water for Egypt, with an annual flow of 55.5 Mm^3/year. Underground water in the Nile valley and Delta is estimated at 6.9 Mm^3/year. Agricultural sewage water recycling is estimated at 11.9 Mm^3/year. The waste water recycling is estimated at 1.2 Mm^3/year. Rains and floods are estimated at 0.65 Mm^3/year. Sea water desalination is estimated at 0.1 Mm^3/year. The total actual renewable water resources of the country are thus 76.3 km^3/year. Total cultivated area is 9095705 Feddan in 2015 with a water consumption 80% of total available water resources **(FAO STAT Database, 2012).**

Egypt is facing increasing water needs, caused by a rapidly growing population, an increased urbanization, higher standards of living, and by an agricultural policy which focuses on increasing production in order to feed the growing population. This means that Egypt has to do more with less water **(Allam et al., 2005).**

Agricultural activities in Egypt engages about 55% of the labor force, while contributing about 13% to the GDP (**CAPMAS, 2015**). The “Old-land” at the Nile Valley and the Nile Delta represents about 80% of the cultivated area, with “New-land” representing the rest. The cultivated land base of Egypt is about 3.5 million hectares, with a total annual cropping area of about 6.2 million hectares.

Agriculture in Egypt is one of the unique examples of full irrigation application, that Egypt has one of the most complicated irrigation systems covering almost all the agricultural areas along the nation. Due to the different conditions of soil, availability and quality of water and climatic conditions, Egypt has a vast variation of crops, including food, fiber, and oil crops **(IFAD, 2012).**

Egypt has one of the most complicated irrigation systems covering almost all the agricultural areas along the nation. Where, the irrigated