RATIONALIZATION OF WATER CONSUMPTION OF TOMATO PLANTS GROWN UNDER SANDY SOIL CONDITIONS

By

SAMEH MOHAMED MOHAMED EL-SAWY
B. Sc. Agric. Sc. (Horticulture), Ain Shams University, 2001
M. Sc. Agric. Sc. (Vegetable Crops), Ain Shams University, 2009

A thesis submitted in partial fulfillment

Of

the requirements for the degree of

DOCTOR OF PHILOSOPHY

in
Agriculture Science
(Vegetable Crops)

Department of Horticulture
Faculty of Agriculture
Ain Shams University

2016

Approval Sheet

RATIONALIZATION OF WATER CONSUMPTION OF TOMATO PLANTS GROWN UNDER SANDY SOIL CONDITIONS

By

SAMEH MOHAMED MOHAMED EL-SAWY

B. Sc. Agric. Sc. (Horticulture), Ain Shams University, 2001
M. Sc. Agric. Sc. (Vegetable Crops), Ain Shams University, 2009

This thesis for Ph.D. degree has been approved by:

Dr. Kawther Kamel Ahmed Dawa **……...…….…**

Prof. Emeritus of Vegetable Crops, Faculty of Agriculture, Masoura University.

Dr. Mohamed Hashem AL-Deep **……...……**

Prof. Emeritus of Vegetable Crops, Faculty of Agriculture, Ain Shams University.

Dr. Mohamed Emam Ragab **……..……..**

Prof. of Vegetable Crops, Faculty of Agriculture, Ain Shams University.

Date of Examination: 12 / 4 / 2016

RATIONALIZATION OF WATER CONSUMPTION OF TOMATO PLANTS GROWN UNDER SANDY SOIL CONDITIONS

By

SAMEH MOHAMED MOHAMED EL-SAWY

B. Sc. Agric. Sc. (Horticulture), Ain Shams University, 2001
M. Sc. Agric. Sc. (Vegetable Crops), Ain Shams University, 2009

Under the supervision of:

Dr. Mohamed Emam Ragab

Prof. of Vegetable Crops, Department of Horticulture, Faculty of Agriculture, Ain Shams University (Principal Supervisor).

Dr. Nesreen Ahmed Sabry Helal

Lecturer of Vegetable Crops, Department of Horticulture, Faculty of Agriculture, Ain Shams University.

Dr. Omaima Mohamed Mohamed Sawan

Researcher Prof. Emeritus of Vegetable Crops, Vegetable Research Dept., Agriculture and Biological Research Division, National Research Centre.

ABSTRACT

Sameh Mohamed Mohamed El-Sawy: Rationalization of Water Consumption of Tomato Plants Grown Under Sandy Soil Conditions. Unpublished Ph. D. Thesis, Department of Horticulture, Faculty of Agriculture, Ain Shams University, 2016.

Field experiment was carried out during the two growing seasons of 2012/2013 and 2013/2014, in a private farm at Bani Salama region, El-Giza Governorate, Egypt, in order to investigate the effect of deficit irrigation (DI) treatments (100% (control), 85%, 70% and 55% of ET_o (Reference evapotranspiration)), irrigation systems (surface drip irrigation (SDI) and subsurface drip irrigation (SSDI) (with 20cm soil depth)) and foliar application of glycine betaine concentrations (GB) (at 0, 5, 10 and 20 mM/l, applied after 2 and 6 weeks from transplanting date), on vegetative growth, fruit yield and quality of tomato plants (Marwa hybrid) grown under sandy soil conditions.

Results indicated that DI treatments (85%, 70% and 55% of ET_o) significantly decreased the vegetative growth (plant length, number of leaves per plant, total leaves area per plant and fresh and dry weights of tomato leaves per plant), flowering (number of flowers, number of clusters per plant) and fruit yield (number of fruits per plant and total marketable yield) parameters for tomato plants. Where, the highest significant values were obtained by the full irrigation treatment 100% ET_o (control) and the lowest values were noticed with 55% ET_o treatment. Similarly, photosynthetic pigments (chlorophyll a, chlorophyll b and carotenoids), leaf relative water content (LRWC), membrane stability index (MSI), leaves mineral content parameters were reduced with decreasing irrigation water levels. In contrast, there were positive effects on proline content of tomato leaf and some fruit quality characteristics (TSS, total sugars, ascorbic acid content and titratable acidity) for tomatoes, as well as on irrigation water use efficiency (IWUE).

Subsurface drip irrigation system produced the highest significant values for vegetative growth, flowering and fruit yield and quality

parameters, compared to SDI system, as well as the highest significant values for LRWC, MSI and IWUE were observed with SSDI system in the both tested seasons. Results showed that when DI treatments (85%, 70% and 55% ET_o) decreased total marketable yield by (16.05%, 26.73% and 46.61%) and (16.01%, 27.29% and 46.96%), while SSDI system positively increased it by (4.31% and 4.85% and 4.38%) and (2.49%, and 5.54% and 5.80%), in the first and second seasons, respectively.

Foliar application of GB at 10 mM/l ameliorated the negative effects of water stress and produced the highest significant values of vegetative growth, flowering parameters, photosynthetic pigments, LRWC and MSI in the both studied seasons. While, there were no significant differences were realized among the GB treatments on the most of fruit quality characteristics. Results reported that, When DI treatments (85%, 70% and 55% ET_o) decreased total marketable yield by (14.38%, 25.08% and 48.77%) and (14.23%, 24.78% and 47.03%), the foliar application of glycine betaine (at 10 mM/l) increased it by (10.95%, 10.11% and 22.85%) and (12.92%, 9.26% and 20.74%), in the first and second seasons, respectively.

The interaction among DI treatments, irrigation systems (IS) and foliar application of GB illustrated that tomato plants were irrigated by 100% and 85% ET_o with SSDI system and foliar application of GB at 10 mM/l had the highest significant values for vegetative growth, flowering and fruit yield and quality of tomato plants under open field conditions. It was also concluded that the vegetative growth and fruit yield as well as fruit quality of tomato plants which grown under DI conditions, can be enhanced by using SSDI system and foliar application of GB at 10 mM/l.

Key words: Tomato, Deficit irrigation, Irrigation systems, Subsurface drip irrigation, Glycine betaine, Yield, Fruit quality, IWUE, LRWC, MSI.

ACKNOWLEDGEMENT

Praise and thanks to **Allah**, who guided and helped us to achieve this work.

The writer wishes to express his gratitude and sincere thanks to **Prof. Dr. Mohamed Emam Ragab**, Professor of Vegetable Crops, Dept. of Horticulture, Faculty of Agric., Ain Shams Univ., for his supervision, kind help, moral and faithful attitude during the preparation of this manuscript, follow up, constructive ideas and advice and reviewing the manuscript.

My grateful thanks to **Dr. Nesreen Ahmed Sabry Helal,** Lecturer of Vegetable Crops, Dept. of Horticulture, Faculty of Agric., Ain Shams Univ., for her kind supervision and valuable assistance during the work.

Deepest and sincere gratitude and appreciation to **Dr. Yasser Ezzat Hashem Arafa,** Assistant Prof. Agricultural Engineering Dept., Faculty of Agric., Ain Shams Univ., for his kind supervision and valuable assistance during the work.

Sincere and deep gratitude to **Prof. Dr. Omaima Mohamed Mohamed Sawan,** Professor Emeritus of Vegetable Crops Dept., National Research Centre, for her supervision, encouragement and valuable helping throughout this study.

My sincere thanks, gratitude and appreciation to **Prof. Dr. Zakaria Fouad Fawzy and Prof. Dr. Abd El-Mohsen El-Basiony,** Professors of Vegetable Crops Dept., National Research Centre, for their continuous supervision, valuable help and Keen review.

My sincere thanks, gratitude and appreciation to **Prof. Dr. Taha El-Shorbagy** and **Dr. Emad El-din Hassanein Abd El-Samad,** Professors of Vegetable Crops Dept., National Research Centre, for their kind help and facilities granted during this work.

My grateful thanks to **all staff members of Vegetable Research Dept.,** National Research Centre.

My heart full thanks and sincere appreciation to **my family**, for their helpful support and encouragement all over my life.

CONTENTS

LIST OF TABLES