EFFECT OF IRRIGATION WITH SALINE WATER AND CLOVER-BASED ORGANIC AMENDMENT IN GROWING MEDIUM FOR ORGANIC TOMATO TRANSPLANTS PRODUCTION

By

AYMAN RAGAB ABU EL ELA MOHAMED
B.Sc. Agric. Sci.(Land Reclamation), Cairo University, 2003

A Thesis Submitted in Partial Fulfillment

Of

The Requirements for the Degree of

MASTER OF SCIENCE
in

Agricultural Sciences
(Agriculture and Desert Areas Affected by Salinity)

Arid Lands Agricultural Graduate and Research Institute
Faculty of Agriculture
Ain Shams University

2018

Approval Sheet

EFFECT OF IRRIGATION WITH SALINE WATER AND CLOVER-BASED ORGANIC AMENDMENT IN GROWING MEDIUM FOR ORGANIC TOMATO TRANSPLANTS PRODUCTION

By

AYMAN RAGAB ABU EL ELA MOHAMED
B.Sc. Agric. Sci.(Land Reclamation), Cairo University, 2003

This thesis for M. Sc. degree has been approved by:

Dr. Shamel Ahmed Shanan **……………….……**
Prof. Emeritus of Vegetable Crops, Faculty of Agriculture, Al-Azhar University

Dr. Ayman Farid Abou Hadid **……………….……**
Prof. Emeritus of Vegetable Crops, Faculty of Agriculture, Ain Shams University

Dr. Usama Ahmed Ali El- Behairy **……………….……**
Prof. of Vegetable Crops, Faculty of Agriculture, Ain Shams University

Dr. Mamdouh Mohamed Fawzy Abdallah **……………….……**
Prof. Emeritus of Vegetable Crops, Faculty of Agriculture, Ain Shams University

Date of Examination: 26/4/ 2018

EFFECT OF IRRIGATION WITH SALINE WATER AND CLOVER-BASED ORGANIC AMENDMENT IN GROWING MEDIUM FOR ORGANIC TOMATO TRANSPLANTS PRODUCTION

By

AYMAN RAGAB ABU EL ELA MOHAMED
B.Sc. Agric. Sci.(Land Reclamation), Cairo University, 2003

Under the supervision of:

Dr. Mamdouh Mohamed Fawzy Abdallah
Prof. Emeritus of Vegetables Crops, Department of Horticulture, Faculty of Agriculture, Ain Shams University (Principal Supervisor).

Dr. Usama Ahmed Ali El- Behairy
Prof. of Vegetables Crops, Department of Horticulture, Faculty of Agriculture, Ain Shams University.

Dr. Karam Ahmmed Farrag
Researcher. of Soil, Soil Department Central Lab. For Environmental Quality Monitoring (CLEQM), National Water Research Center, Egypt.

ABSTRACT

Ayman Ragab Abu El Ela Mohamed. Effect of irrigation with saline water and clover-based organic amendment in growing medium for organic tomato transplants production. Unpublished M.Sc. Thesis, Department of Agriculture and desert areas affected by salinity, Faculty of Agriculture, Ain Shams University, 2018.

This study was conducted to evaluate the growth of tomato transplants irrigated with saline water in a commercial soilless potting media amended with fermented Egyptian clover produced by anaerobic fermentation of a mixture of clover and water for different periods (1, 2 and 3 weeks). Treatments were distributed in in completely randomized factorial design included three salinity levels in irrigation water (260, 1000 and 2000 mg l^{-1}) without and with fermented clover corresponding to 0, 10, 20 and 30% of the substrate (1peat: 1perlite: 1vermiculite) by volume. Plant height (cm), number of leaves (N°), vegetative fresh and dry weights (g) per plant were recorded 35 days after sowing. Further, selected chemical constitutes of leaves such as content of NPK (mg kg^{-1}) and chlorophyll a+b (mg l^{-1}) were determined. The obtained results showed that the mean values of the aforementioned parameters were increased due to the incorporation of clover-based amendment with higher pronounced effect recorded for fermented clover as compared to non-fermented clover. The highest values were obtained due to the incorporation of three weeks fermented clover at 20% mixing percentage followed by 30%. There were significant differences among water salinity treatments; fresh water (260 mg l^{-1}) recorded the highest vegetative growth of tomato transplants. Furthermore, fermented clover alleviated the salt stress on plants and increased the growth parameters under saline water irrigation. These results suggested that clover can be used, instead of imported media, supporting by fermentation to enhance the ability of clover to supplement the transplants with the nutrient needs and cope the salinity condition.

Keywords: Tomato seedling, clover amendments, fermentation, saline water.

ACKNOWLEDGEMENTS

Praise and thanks to **ALLAH**, who guided and helped me to achieve this work.

The writer wishes to express his gratitude and sincere thanks to Prof. Dr. Mamdouh Mohamed Fawzy Abdallah, Professor of Vegetable, Horticulture Department, Faculty of Agriculture, Ain Shams University, for his supervision, reviewing the manuscript, fruitful discussion during this work and for his valuable advices while carrying out this research work. He is an excellent supervisor, gave me stimulating suggestions and he was available at all times when I need his help and advice. It is a great honor to work under his supervision.

Deepest and sincere gratitude and appreciation to Prof. Dr. Usama Ahmed El-Behairy Professor of Vegetable Crops, Horticulture Department, Faculty of Agriculture, Ain Shams University, for his kind supervision, valuable assistance, moral and faithful attitude during the preparation of this manuscript.

I wish to express my deepest grateful thanks and sincere to Dr. Karam Farrag, Researcher in Soil Department, Central Lab. for Environmental Quality Monitoring (CLEQM), National Water Research Center, Egypt, for his supervision, valuable assistance, moral and faithful attitude during the preparation of this manuscript, this great professor prefers me more than his family and give me all his time and his effort to finalize this research .

My grateful thanks also to all staff members of Arid and Agricultural Research and Service Center, Faculty of Agriculture, Ain Shams University, for their kind help and facilities granted during this work. Finally, my heart full of thanks and sincere appreciation to my family (wife, sons), for they helpful support and encouragement all over my life.

CONTENTS

Title	Page

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

1.1 Problem Statement

Production of uniform, vigorous vegetable transplants is the first step to ensuring rapid crop establishment and good performance in the field **(Jack *et al.*, 2011)**. Growing mediums are the materials, other than soils, in which plants are grown. These covers different substances such as organic (peat, compost, tree bark, coconut, sawdust etc.) and inorganic materials (clay, perlite, vermiculite, mineral wool, volcanic tuff, etc.), While these substrates can be used alone, mixtures of the substrates such as peat and perlite; coir and clay, peat and compost are also be used widely **(Grunert *et al.*, 2008; Vaughn *et al.*, 2011; Nair *et al.*, 2011; Olle *et al.*, 2012)**. The different growing materials are used to achieve the correct balance of air and water holding capacity for the plants to be grown as well as for the long-term stability of the medium **(Nair *et al.*, 2011)**. Therefore, one of the most important factors in creating a soilless culture is pick a suitable substrate **(Olympios, 1995)**.

There are many different materials that have been used for vegetable and fruit production. Throughout the world, the raw materials used vary based on their local availability **(Schmilewski, 2009)**. Such raw materials can be inorganic or organic, but growing media are often formulated from a blend of different raw materials in order to achieve the correct balance of air and water holding capacity for the plants to be grown as well as for the long-term stability of the medium **(Bilderback *et al.*, 2005; Nair *et al.*, 2011)**. It is reported that a high percentage of inorganic growing media such as rock wool, sand, perlite, vermiculite, pumice, clays, and others, are used in soilless plant production while only about 12% uses organic growing media such as peat, bark, wood residues, coir, bagasse, rice hulls, alfalfa amendment and others **(Donnan, 1998; Sawan *et al.*, 1999; Böhme *et al.*, 2001; Böhme *et al.*, 2008)**. However, there is no growing medium that can be labeled as the “best” since each particular medium has both advantages and disadvantages. Several factors determine the type of growing medium appropriate for specific growing conditions.

Production of transplants in small cells in peat-based medium is the most common and widely practiced method **(Raviv *et al.*, 1986)**. To obtain healthy transplants, it is a common practice to fertilize medium with amendments or water-soluble fertilizers that provide nitrogen (N), phosphorus (P), potassium (K), and other nutrients to the developing seedlings **(Weston and Zandstra, 1989)**. The nutrient management aspect for conventionally grown transplants has been extensively researched and largely optimized; however, there are challenges for organic transplant production. There is little information available on aspects such as nutrient management in organic transplant production; as a result, organically produced transplants are often of low quality **(Diaz-Perez et *al.*, 2008)**. With increase in demand for organically grown transplants, a number of soluble organic fertilizers and supplements have emerged in the market **(Kuepper and Everett, 2004; Treadwell *et al.*, 2007)**.

These products are usually expensive and not always locally available **(Peet *et al.*, 2008)**. Growers often design their own mixes using compost and other organic amendments. Organic growers largely depend on compost to manage nutrient requirements of growing transplants. Incorporation of large proportions of compost in the growing medium is not warranted because it can lead to increased salinity and could adversely affect seed germination, seedling growth, and yield **(Clark and Cavigelli, 2005; Sanchez-Monedero *et al.*, 2004)**. Compost nutrient quality also varies based on raw materials used and process and duration of composting. Additionally, it is difficult to synchronize nitrogen mineralization from the compost-amended medium with crop N demand **(Treadwell et *al.*, 2007)**. Supplementing compost-amended medium with a standardized organic amendment serves as a viable alternative for nutrient management in organic transplant production. There are a number of organic N sources available such as alfalfa meal, soybean meal, and blood meal. Most of these amendments have not been tested thoroughly despite their popularity and widespread use by growers **(Hochmuth *et al.*, 2006)**. In most cases after incorporation of organic amendments, a certain period of time is required for N mineralization **(Agehara and Warncke, 2005)**. In certain cases it is recommended that the plant-based amendment be mixed into the potting medium two weeks before sowing of seeds to prevent seed injury. **Nair *et al.*, (2011)** tested the use of a peat-compost- based growing mix supplemented with an alfalfa-based organic amendment derived from alfalfa, meat meal, molasses, and potash for organic tomato transplant production. The author concluded that application rate of 0.6% or 1.2% of alfalfa-based amendment produced transplants with suitable growth characteristics and met commercially acceptable standards for transplanting and handling at a reasonable estimated cost **(Nair *et al.*, 2011)**.

On the other hand, competition for available fresh water resources has resulted in development of irrigation with saline water **(Ghassemi *et al.*, 1995)**. Tomato is moderately tolerant to salinity and could act as a model crop for saline water use because it is already cultivated in a few warm and rather dry areas where irrigation is essential for high yield **(Zayton *et al.*, 2009)**. Several saline/brackish water irrigation researches were carried out on open culture tomatoes **(Zayton *et al.*, 2009)**. The results evidently revealed that if suitable management practices were adapted, it is feasible to irrigate tomato using relatively high saline water under arid conditions **(Zayton *et al.*, 2009)**.

The tomato response to salt stress is differently regulated in different development stages **(Costa *et al.*, 1990; Saranga *et al.*, 1992; Foolad, 2004)**. Salinity slows down tomato shoot growth and the growth of younger seedlings; the higher the saline concentration the larger the reduction in shoot growth **(Cuartero and Fernandez-Munoz, 1999;**