

THE ROLE OF BIOTIC AND ABIOTIC AGENTS IN CONTROLLING TOMATO EARLY BLIGHT DISEASE

By

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B.Sc. Agric. Sci. (Plant Protection), Fac. Agric., Cairo Univ., 2005

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THESIS

**Submitted in Partial Fulfillment of the
Requirements for the Degree of**

DOCTOR OF PHILOSOPHY

In

**Agricultural Sciences
(Plant Pathology)**

**Department of Plant Pathology
Faculty of Agriculture
Cairo University
EGYPT**

2019

SUPERVISION SHEET

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Title of Thesis: The Role of Biotic and Abiotic Agents in Controlling
Tomato Early Blight disease.
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ABSTRACT

The objectives of the present work were designed to isolate and identify the causal organism of tomato early blight disease and evaluate its pathogenic ability to induce disease incidence. Some biotic, *i.e.* *Trichoderma harzianum* and *T. viride* or antagonistic bacteria, *Bacillus subtilis* and *Pseudomonas fluorescens* and abiotic factors, *i.e.* essential oils, mineral salts, organic acids, chitosan and fungicides were *in vitro* evaluated against the growth of the pathogen in order to find out the most suitable and applicable biological and chemical methods for controlling early blight disease of tomato under field conditions. The obtained results proved that all tested bio-agents drastically reduced the linear growth of *A.solani*. Whereas, *T. harzianum* and *B. subtilis* showed superior inhibitory effect on fungal growth compared to *T. viride* and *P. fluorescens*. All evaluated essential oils, mineral salts, organic acids, chitosan and fungicide's concentrations significantly reduced the fungal linear growth. Chitosan caused complete reduction in linear fungal growth at concentration of 2 g/l. All tested essential oils had inhibitory effect on fungal growth, as well as the *in vitro* determined secondary metabolites with fungicidal or fungistatic activity, since they allow the use of natural origin compounds that are generally species specific, have low environmental persistence, and are biodegradable. Plastic house results revealed that all the applied treatments reduced both disease incidence and severity, compared with untreated control. Chitosan, Salicylic acid, Lemon grass oil and/or *T. harzianum* had superior significant effect on reducing both disease incidence and severity, followed by Thyme oil, Citric acid, potassium sorbate, *T. viride* and *B. subtilis*, respectively. Under artificial infestation with disease incident, reduction in both disease incidence and severity was observed when all treatments were sprayed before inoculation under plastic house conditions (protective) and/or after inoculation under plastic house conditions (curative). Under natural infection, the lowest appearance of Early blight disease incidence and severity were observed when treatments were applied as foliar spray with the best treatments of biotic, *i.e.* *T. harzianum* and antagonistic bacteria, *i.e.* *B. subtilis* and abiotic factors, *i.e.* Thyme, Lemon grass, Potassium sorbate, Chitosan, Salicylic acid, Citric acid and Ridomil Gold MZ. The activity of Catalase, Glutathione Reduced, Chitinase, Glutathione peroxidase and Total Antioxidant Capacity enzymes were highly increased in tomato plant naturally infested with *A. solani* in response to three times of foliar spray with different treatments of biotic and abiotic agents.

Application of biotic and abiotic factors considered active against disease incidence as well as safe, cheap, easily applicable methods, in addition they avoid environmental pollution.

Key words: Abiotic agents, *Alternaria solani*, Biotic agents, Chitosan, Early blight, Essential oils, Mineral salts, Organic acids, Tomato.

DEDICATION

I would like to dedicate this work to whom my heartfelt thanks; to my late mother, my father, my wife, my children, my brothers for their encouragement and patience during my post-graduate studies.

Also, I dedicate this work to all of my friends.

WITH MY GRATITUDE AND LOVE

ACKNOWLEDGEMENT

First of all and foremost, the unlimited thanks to (Allah).

*The investigator wishes to express his deepest sincere gratitude to **Dr. Mona Mahmoud Maher Ragab** Professor of Plant Pathology, Faculty of Agriculture, Cairo University, for her supervision, great assistance, valuable criticism, guidance and encouragement throughout the course of study.*

*Thanks also extended to the spirit of **Dr. Ahmed Mohamed Abdel-Kader Ashour** late Professor of Plant Pathology, Faculty of Agriculture, Cairo University, for his help and kind supervision.*

*Cordial indebt to **Dr. Mokhtar Mohamed Abdel-Kader** Researcher Professor of Plant Pathology, N.R.C., for continued assistance, sharing in supervision, patience, advice, guidance, support and encouragement throughout this work,*

*The Researcher wishes also to express his special deepest gratitude to **Dr. Nehal Samy El-Mougy** Researcher Professor of Plant Pathology, N.R.C., and **Dr. Hanaa Abdel-Baki** Researcher Professor of Plant Biotechnology, N.R.C., for their help during this work,*

*Many thanks and valuable gratitude is due to **Dr. Kamelia M. Osman**, Professor of Microbiology Department, Faculty of Veterinary Medicine, Cairo University, for her help during this work,*

Grateful appreciation is also extended to all staff members of Plant Pathology Department, Faculty of Agriculture, Cairo University and Plant Pathology Department, N.R.C., for their help and providing facilities needed throughout executing this investigation.

*Also, I feel deeply grateful to my dear country **Egypt**.*

CONTENTS

	Page
INTRODUCTION	1
REVIEW OF LITERATURE	6
1. The casual pathogen of Tomato Early blight disease.....	6
2. Disease symptoms	9
3. Economic losses and importance	11
4. Widespread of disease incidence	13
5. Isolation and identification of the causal organism	15
6. Pathogenicity and Pathogenic mechanisms of <i>Alternaria solani</i>	17
7. Control measures of early blight disease.....	24
a. Biotic factor (Biological control).....	24
b. Abiotic Factors.....	34
1. Essential oils	35
2. Mineral salts	42
3. Organic acids.....	45
4. Chitosan	49
5. Fungicides	51
8. Biochemical studies on the defense mechanisms of plant (Enzymatic activity in plant)	56
MATERIALS AND METHODS	68
1. Survey of tomato early blight disease at different governorates in Egypt	68
2. Isolation, purification and identification of the causal fungi.....	68
3. Pathogenicity tests.....	70
4. Control measures against <i>Alternaria solani</i> causing early blight disease in tomato plants	72
a. Laboratory experiments	72
1. Effect of different semi-synthetic media on the linear growth of <i>A. solani</i>	72
2. Effect of Bio control agent (BAs) on the linear growth of <i>A. solani</i>	73
3. Effect of Essential oils (EOs) on the linear growth of <i>A. solani</i>	74

4. Effect of some mineral salts on the linear growth of <i>A. solani</i>	77
5. Effect of some Organic acid on the linear growth of <i>A. solani</i>	79
6. Effect of Chitosan on the linear growth of <i>A. solani</i>	80
7. Effect of some fungicides on the linear growth of <i>A. solani</i>	81
b. Management of early blight disease under plastic house conditions.....	82
c. Biochemical studies (Determination of enzymes activity)	89
5. Statistical analysis.....	94
RESULTS AND DISCUSSION	96
1. Survey of tomato early blight disease at different governorates in Egypt.	96
2. Isolation, purification and identification of the causal fungi.....	99
3. Isolation, purification and identification of antagonistic micro- organisms.....	102
4. Pathogenicity test.....	104
5. Control measures against <i>Alternaria solani</i> causing early blight disease in tomato plants.	107
A. Laboratory experiments.....	107
B. Plastic house experiments.....	153
1. Plastic house experiments under artificial infestation.....	153
2. Plastic house experiments under natural infestation	183
C. Effect on tomato fruit yield.....	188
D. Biochemical studies (Determination of enzymes activity)...	206
1. Effect on Catalase (CAT) activity	206
2. Effect on Glutathione reduced (GR) activity	210
3. Effect on Chitinase (CH) activity	212
4. Effect on Glutathione Peroxidase (GP) activity	215
5. Effect on Total antioxidant capacity (TAC) activity	217
SUMMARY	250
REFERENCES	258
ARABIC SUMMARY	

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is the most popular, important and widely-grown vegetable food crop in the world because of its taste, color, protective and high nutritive value, as well as, its diversified daily use. Tomato belongs to the family Solanaceae. It is a diploid plant with $2n = 24$ chromosomes (Ahmed *et al.*, 2010). It is the world's largest vegetable crop after potato and sweet potato, as it tops the list of canned vegetables. In addition, in some countries, the tomato plant is considered one of the main food crops produced and consumed (Akila *et al.*, 2012 and Itako *et al.*, 2013).

Tomato is one of the important plants, which contribute in maintaining human health and vigor. It is considered as highly nutritious because of its high contents of vitamin A, B, C, β -carotene, and important mineral (*e.g.*, phosphorus and calcium), organic acids, antibiotic properties, fibers, as well as calories. It is also characterized by its high content of lycopene, a natural antioxidant, which is not found in the other solanaceous crops. It also has niacin 0.712 mg, calcium 31 mg and water 94.28 g per 100 g weight. It is a good source (Ahmed *et al.*, 2010; Akila *et al.*, 2012; Anuj *et al.*, 2015 and Chohan *et al.*, 2015).

Tomato production accounts for 14% of the total fruit and vegetable production worldwide, *i.e.* about 152.9 million tons; \$74.1 billion (Babu *et al.*, 2000; Agrios, 2005 and Selim, 2015). The global tomato production area covers approximately 4 million hectares (Ahmed *et al.*, 2010; 2014 and Selim, 2015). Noteworthy, tomato is the most important vegetable crop in Egypt, and Egypt is among the top 10