

**EFFECT OF SOLAR HEATING, CHEMICAL  
DISINFESTANTS AND SOME BIOLOGICAL  
AGENTS ON LETTUCE FUSARIUM WILT  
CONTROL, YIELD AND QUALITY**

**By**

**AMR MAHMOUD HANAFY DSOKY**

**B.Sc. Agric. Sci. (Plant Production), Fac. Agric., Cairo Univ., 2012**

**THESIS**

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

**MASTER OF SCIENCE**

**In**

**Agricultural Sciences  
(Vegetable Crops)**

**Department of Vegetable Crops  
Faculty of Agriculture  
Cairo University  
EGYPT**

**2018**

Format Reviewer

Vice Dean of Graduate Studies



**APPROVAL SHEET**

**EFFECT OF SOLAR HEATING, CHEMICAL  
DISINFESTANTS AND SOME BIOLOGICAL  
AGENTS ON LETTUCE FUSARIUM WILT  
CONTROL, YIELD AND QUALITY**

**M.Sc. Thesis**

**In**

**Agric. Sci. (Vegetable Crops)**

**By**

**AMR MAHMOUD HANAFY DSOKY**

**B.Sc. Agric. Sci. (Plant Production), Fac. Agric., Cairo Univ., 2012**

**APPROVAL COMMITTEE**

**Dr. FAWZY MORSI ABO EL-ABBAS**.....

**Professor of Plant Pathology, Fac. Agric., Ain-Shams University**

**Dr. HASSAN ALI HASSAN** .....

**Professor of Vegetable Crops, Fac. Agric., Cairo University**

**Dr. SAYED FATHEY EL SAYED** .....

**Professor of Vegetable Crops, Fac. Agric., Cairo University**

**Date: 27/9/2018**



**SUPERVISION SHEET**

**EFFECT OF SOLAR HEATING, CHEMICAL  
DISINFESTANTS AND SOME BIOLOGICAL  
AGENTS ON LETTUCE FUSARIUM WILT  
CONTROL, YIELD AND QUALITY**

**M.Sc. Thesis**

**In**

**Agric. Sci. (Vegetable crops)**

**By**

**AMR MAHMOUD HANAFY DSOKY**

**B.Sc. Agric. Sci. (Plant Production), Fac. Agric., Cairo Univ., 2012**

**SUPERVISION COMMITTEE**

**Dr. SAYED FATHEY EL SAYED**

**Professor of Vegetable Crops, Fac. Agric., Cairo University**

**Dr. AHMED ABDEL-WAHAB**

**Lecturer of Vegetable Crops, Fac. Agric., Cairo University**

**Dr. NOUR EL-HOUDA ABD EL-TAWAB REYAD**

**Lecturer of Plant Pathology, Fac. Agric., Cairo University**



**Name of Candidate:** Amr Mahmoud Hanafy Dsoky      **Degree:** M.Sc.  
**Title of Thesis:** Effect of Solar Heating, Chemical Disinfestants and Some  
Biological Agents on Lettuce Fusarium Wilt Control, Yield  
and Quality  
**Supervisors:** Dr. Sayed Fathey El Sayed  
Dr. Ahmed Abdel-Wahab  
Dr. Nour El-Houda Abd El-Tawab Reyad  
**Department:** Vegetable crops      **Branch:** -  
**Approval:** 27 / 9 / 2018

### ABSTRACT

Isolation trials from lettuce plant with wilt symptoms collected from Giza, Qalubiya and Behera Governorates yielded *Fusarium oxysporum* Schlecht, *Macrophomina phaseolina* (Tassi) Goid and *Mucor* sp. Fresen. The isolates of the fungus *F. oxysporum* were exposed to pathogenicity test by using lettuce (cv. Aviram) seedlings. The all isolates infected the lettuce seedlings with different levels. Giza isolate as the most virulent morphologically and molecularly characterized as *F. oxysporum*. Also, it was failing to infect non-host plants in the host range test. Temperature degrees, relative humidity levels and root exudates of lettuce seedlings significantly influenced the growth and sporulation of the tested fungus on PDA medium. Three beneficial bacterial isolates (*Pseudomonas fluorescence*, *Bacillus circulence* and *Peanbacillus polymexa*) evaluated for their antagonistic activity against the fungus. In the lab, *Ps. fluorescence* gave the highest antagonistic effect on the fungus growth. In the greenhouse, the bacterial isolates were tested against the disease occurrence and compared with three commercial bioproducts (T34 biocontrol, ESRU biocontrol and algae extract). T34 biocontrol and ESRU biocontrol were the best treatments while the bacterial isolates were exerted no effect on the disease. In the field, solar heating, metam sodium, T34 biocontrol, ESRU biocontrol and Tebuconazole 6% fungicide were tested in naturally infested soil with the pathogen during 2015 and 2016 growing seasons. Solarization and metam sodium gave the highest reduction in the disease incidence and severity. Also, improved the growth and yield characteristics of the lettuce plants.

**Keywords:** Lettuce, Fusarium wilt, solar heating, metam sodium, biocontrol, rDNA, ITS region





## **ACKNOWLEDGMENT**

*I wish to express my deepest thanks and appreciation to my mentor and supervisor **Dr. Sayed Fathey El Sayed**, Emeritus Professor of Vegetable Crops, Faculty of Agriculture, Cairo University, for being generous with his time and knowledge, his kind guidance, motivation, valuable discussion and suggestion during the whole course of this investigation and writing of the manuscript.*

*Further, I gratefully acknowledge **Dr. Ahmed Abdel-wahab**, Lecturer of Vegetable Crops, Faculty of Agriculture, Cairo University, for suggesting the research problem, supervision, providing materials, help in the field.*

*My deepest thanks are also to **Dr. Nour El-Houda Abd El-Tawab Reyad**, Lecturer of Plant Pathology, Faculty of Agriculture, Cairo University, for her supervision, friendly attitude, help in the field and during the stage of analyzing the data and writing of the manuscript. I greatly appreciate her constant support and patience over the past three years.*

*I would like to especially thank, **Dr. Fawzy Morsi Abo El-Abbas**, Emeritus Professor of Plant Pathology, Faculty of Agriculture, Ain-Shams University and **Dr. Nabil A. Hegazi**, Emeritus Professor of Microbiology Department, Faculty of Agriculture, Cairo University, none of this work have been possible without their help, support and guidance.*

*Finally, but not least, I would like to extend my sincere thanks to my family, first, my parents, my wife and my daughters for their love and support.*



## LIST OF ABBREVIATIONS AND INITIALS

Assiut University Mycological Center	:	AUMC
Biocontrol agents	:	BCAs
Carbon disulfide	:	C <sub>2</sub> S
Chlorophyll	:	Chl
Colony forming unit	:	CFU
Compost	:	COM
Environmental Studies and Research Unit	:	ESRU
Food and Agriculture Organization	:	FAO
<i>Fusarium oxysporum</i> f. sp. <i>Lactuca</i> e	:	FOL
Increased plant growth response	:	IGR
Internal Transcribed Spacer	:	ITS
Metam sodium	:	MS
Percent	:	%
Polymerase Chain Reaction	:	PCR
Potato dextrose agar	:	PDA
Relative humidity	:	R.H
Rice straw biochar	:	RSB
Total soluble solids	:	T.S.S
Vesicular arbuscular mycorrhiza	:	VAM



# CONTENTS

	Page
<b>INTRODUCTION.....</b>	<b>1</b>
<b>REVIEW OF LITERATURE.....</b>	<b>7</b>
<b>1. Occurrence of lettuce Fusarium wilt .....</b>	<b>7</b>
<b>2. Impact of lettuce Fusarium wilt on lettuce production...</b>	<b>8</b>
<b>3. Symptoms of lettuce Fusarium wilt .....</b>	<b>8</b>
<b>4. Disease cycle and epidemiology of FOL.....</b>	<b>9</b>
<b>5. Identification of FOL.....</b>	<b>12</b>
<b>6. Host range .....</b>	<b>13</b>
<b>7. Factors affecting the growth of FOL.....</b>	<b>14</b>
a. Temperature degrees.....	14
b. Relative humidity levels.....	14
c. Lettuce root exudates.....	15
<b>8. Biochemical changes in lettuce plants due to infection         by FOL.....</b>	<b>16</b>
<b>9. Disease control.....</b>	<b>17</b>
a. Soil amendments .....	17
b. Biocontrol agents.....	17
c. Solarization .....	19
d. Chemical fumigation.....	19
<b>10. Effect of some treatments on growth characteristics,         yield and chemical properties of lettuce         plants.....</b>	<b>20</b>
a. Effect of some treatments on growth characteristics, yield of lettuce plants.....	20
b. Effect of some treatments on chemical properties of lettuce plants.....	28
<b>11. Effect of solarization and chemical fumigation on soil         microorganisms.....</b>	<b>31</b>
a. Solarization.....	31
b. Chemical fumigation.....	34
<b>12. Effect of solarization on soil temperatures .....</b>	<b>37</b>
<b>13. Effect of solarization and chemical fumigation on         weeds density.....</b>	<b>39</b>
<b>14. Metam sodium residue in lettuce leaf tissues .....</b>	<b>40</b>



<b>MATERIALS AND METHODS.....</b>	<b>41</b>
<b>RESULTS.....</b>	<b>57</b>
<b>1. Isolation of the associated microorganisms .....</b>	<b>57</b>
<b>2. Pathogenicity test.....</b>	<b>57</b>
<b>3. Identification of FOL.....</b>	<b>58</b>
a. Morphological characteristics.....	58
b. Molecular characteristics.....	60
<b>4. Host range.....</b>	<b>61</b>
<b>5. Factors affecting mycelial growth and sporulation of FOL .....</b>	<b>62</b>
a. Temperatures.....	62
b. Relative humidity levels.....	64
c. Lettuce root exudates.....	65
<b>6. Biochemical changes in lettuce plants due to infection by FOL.....</b>	<b>66</b>
<b>7. Disease control.....</b>	<b>67</b>
a. Soil amendments.....	67
b. Effect of solarization, chemical fumigation and some biological agents on lettuce Fusarium wilt control, yield and quality (Field experiment) .....	70
<b>8. Determination of MS residue in the leaves of lettuce plants.....</b>	<b>86</b>
<b>DISCUSSION.....</b>	<b>89</b>
<b>SUMMARY.....</b>	<b>105</b>
<b>REFERENCES.....</b>	<b>111</b>
<b>ARABIC SUMMARY</b>	