EFFECT OF NANOPARTICLES AND BIOAGENTS TO INDUCE RESISTANCE IN WHEAT PLANTS AGAINST POWDERY MILDEW DISEASE

By

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B.Sc. Agric. Sci. (Plant Pathology), Fayoum University, 2011

A Thesis Submitted in Partial Fulfillment
Of
The Requirements for the Degree of

MASTER OF SCIENCE
in

Agricultural Science
(Plant Pathology)

Department of Plant Pathology
Faculty of Agriculture
Ain Shams University

2019

Approval Sheet

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ABSTRACT

Mohamed Gamal Farhat Mahmoud. "Effect of Nanoparticles and Bioagents to Induce Resistance in Wheat Plants Against Powdery Mildew Disease". Unpublished M.Sc. Thesis, Department of Plant Pathology, Faculty of Agriculture, Ain Shams University, 2018

Powdery mildew disease caused by *Blumeria graminis* f. sp. *tritici* (Bgt) is one of the most serious diseases of wheat (*Triticum aestivum L*. emThell.) in Egypt and world-wide. The effect of nanoparticles of silicon and titanium, bioagents and chemical inducers against powdery mildew disease of wheat plants was studied, under greenhouse and field conditions. Nanoparticles of silicon and titanium were biologically synthesized from different bacterial and fungal isolates of wheat rhizosphere and phyllosphere. Transmission electron microscopy (TEM) revealed that *Pseudomonas putida* (PpFT1) produced the small size of both nano silicon particles (SiNPs) which ranged from 1.52 to 8.73 nm and nano titanium particles (TiNPs) from 5.81 to 8.95 nm. While, SiNPs and TiNPs that synthesized by *Trichoderma harzianum* (ThFT1) ranged from 5.0 to 9.0 nm and 2.0 to 16.0 nm, respectively. The SiNPs and TiNPs were tested as seed soaking and subsequent foliar spray, treatment, to control powdery mildew on wheat seedling under greenhouse conditions. The most effective treatments were SiNPs at concentration of 100 and 150 ppm synthesized by *P. putida* (PpFT1) and *Bacillus subtilis* (BsBN3) which reduced the powdery mildew severity by 83.3, 89.7, 84.6 and 91.0 % respectively. While, SiNPs at concentration of 150 ppm synthesized by *T. harzianum* (ThFT1) reduced the powdery mildew severity by 82.0 %, TiNPs synthesized by *P. putida* (PpFT1) at concentration of 150 ppm reduced powdery mildew severity by 93.5 % followed by TiNPs synthesized by *P. putida* (PpFT1) at 100 ppm, *Bacillus subtilis* (BsBN3) at 150 ppm and *T. harzianum* (ThFT1) at 100 and 150 ppm which reduced the powdery mildew severity by 84.6, 80.7, 78.2 and 80.7 %.

Under field conditions at two locations in Egypt, in Gelbana (North Sinai) in season 2015/2016 and Nubaria (Beheira) in seasons 2015/2016 and 2016/2017, the most effective treatments were SiNPs and TiNPs. SiNPs and TiNPs bio-synthesized by *Pseudomonas putida* ($PpFT_1$) and *Bacillus subtilis* ($BsBN_3$) reduced disease severity by 92.3, 92.3, and 96.9 and 92.3 % respectively. Meanwhile, methyl jasmonate and arginine reduced powdery mildew severity more than 81.5 % as compared with untreated plants. Moreover**,** the highest reduction in area under disease progress curve (AUDPC) was obtained by SiNPs and TiNPs bio-synthesized by *P. putida* ($PpFT_1$) and *B. subtilis* ($BsBN_3$), in addition to, methyl jasmonate which reduced AUDPC by 89.3, 87.7, 88.1, 88.5 and 83.2 % respectively, followed by SiNPs and TiNPs bio-synthesized by *T. harzianum* ($ThFT_1$), *T. hamatum* ($TmSA_2$), *T. viride* ($TvGK_2$) and *P. fluorescens* ($PfBN_1$) which reduced the disease severity more than 63.5 % compared with untreated plants. However, all tested treatments significantly increased the growth parameters *i.e.* fresh weight of plant (g) and Spike weight (g). Furthermore**,** the highest increase in grain yield was obtained by SiNPs and TiNPs bio-synthesized by *P. putida* ($PpFT_1$), *B. subtilis* ($BsBN_3$) and TiNPs bio-synthesized by *P. polymyxa* ($PbBB_2$) which increased grain yield by more than 211.8 %.

Increases in peroxidase, polyphenol oxidase and chitinase enzymes activities was recorded in wheat plants treated by SiNPs and TiNPs, synthesized by *P. putida* ($PpFT_1$), *Bacillus subtilis* ($BsBN_3$) and *T. harzianum* ($ThFT_1$) in addition to methyl jasmonate. SiNPs and TiNPs synthesized by P. putida (PpFT1), *Bacillus subtilis* (BsBN3) increased total protein and phenols, by more than 100.0%.

Key words: Wheat, Powdery mildew, Nanoparticles, Bioagents, Induced resistance

ACKNOWLEDGMENT

All praises are due to "***Almighty God***", who blessed me with those kind professors and colleagues, who gave me the support to produce this thesis.

I would like to express my deep and sincere gratitude to my supervisor **Prof. Dr. Ahmed Ahmed Ahmed Mosa**, Professor Emeritus of Plant Pathology, Department of Plant Pathology, Faculty of Agriculture, Ain Shams University**,** for supervision of this study, guidance, and critically reviewing the manuscript.

I am greatly indebted to **Prof. Dr. Wafaa Mohamed El-Sayed Haggag,** Prof. of Plant Pathology, Department of Plant Pathology, National Research Center, for this study, her continuous supervision and for the extremely good research and aid facilities. She supported me with constructive supervision, valuable discussion and criticism throughout the course of this Thesis.

Deep thanks and appreciation to **Dr. Marian Shokry Sabet,** Lecturer of Plant Pathology, Department of Plant Pathology, Faculty of Agriculture, Ain Shams University; for her supervision, advice and meticulous observation throughout the work.

Many thanks to **Prof. Dr. Farid Abd-El-Kreem Ibrahim,** Prof. of Plant Pathology, Department of Plant Pathology, National Research Center, for his in-part helping me in training and valuable advice.

Also, I would like to express thanks for **Prof. Dr. Essam Mohamed Hoballah,** Prof. of Microbiology, Department of Microbiology, National Research Center for providing me the wonderful opportunity and the necessary facilities to carry out the research work of biosynthesis of nanomaterials and identification of bacterial isolates.

I gratefully acknowledged the research and technical staff of the Plant Pathology Department, National Research Centre for their assistance. Appreciation is also extended to **all staff members of** Plant Pathology Department, National Research Center, Dokki, Egypt and **all Staff members** of the Department of Plant Pathology, Faculty of Agriculture, Ain Shams University for their support and personal encouragement, valuable help.

Words fail me to express my appreciation to **my parents and my wife** for their support and help me through my life and my study, as well as to **my dear brother** and **sisters** for their support in all my life.

CONTENTS

LIST OF TABLES

LIST OF FIGURES