

**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

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## **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 Unpublished M.Sc.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<sub>1</sub>) and *Bacillus subtilis* (BsBN<sub>3</sub>) 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<sub>1</sub>) and *B. subtilis* (BsBN<sub>3</sub>), 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<sub>1</sub>), *T. hamatum* (TmSA<sub>2</sub>), *T. viride* (TvGK<sub>2</sub>) and *P. fluorescens* (PfBN<sub>1</sub>) 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<sub>1</sub>), *B. subtilis* (BsBN<sub>3</sub>) and TiNPs bio-synthesized by *P. polymyxa* (PbBB<sub>2</sub>) 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<sub>1</sub>), *Bacillus subtilis* (BsBN<sub>3</sub>) and *T. harzianum* (ThFT<sub>1</sub>) in addition to methyl jasmonate. SiNPs and TiNPs synthesized by *P. putida* (PpFT<sub>1</sub>), *Bacillus subtilis* (BsBN<sub>3</sub>) increased total protein and phenols, by more than 100.0%.

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

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