



Ain Shams University  
Faculty of Women  
For Arts, Science and Education

## **Synthesis of nano-chitosan and its application as fertilizer and antifungal on potato**

**A thesis**

**Submitted in partial fulfilment for a Master's degree in Plant physiology**

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

( يَرْفَعُ اللَّهُ الَّذِينَ  
آمَنُوا مِنْكُمْ وَالَّذِينَ  
أَوْثَرُوا الْعِلْمَ دَرَجَاتٍ )

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# Dedication

*TO my kind father and tender mother.*

*TO my sister, brothers and my whole family.*

*TO the persons who taught me patience, strife and pushed me towards success in life and gave me all care and support.*

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## Abbreviation list

<b>Abbreviation</b>	<b>The name</b>
<i>A</i>	Absorbance
<i>ABA</i>	Abcsicic acid
<i>APX</i>	Ascorbate peroxidase
<i>AsA</i>	Ascorbic acid
<i>CAT</i>	Catalase
<i>CK</i>	Cytokinins
<i>CS</i>	Chitosan
<i>DLS</i>	Dynamic light scattering
<i>DW</i>	Dry weight
<i>E</i>	Extinction Coefficient
<i>EM</i>	Emergency
<i>ENMs</i>	Engineered nanomaterials
<i>FAA</i>	Free amino acid
<i>FT-IR</i>	Fourier-transform infrared spectroscopy
<i>FW</i>	Fresh weight
<i>GA</i>	Gibberellins
<i>GC-MC</i>	Gas chromatography–mass spectrometry
<i>GDH</i>	Glutamate dehydrogenase
<i>HPLC</i>	High-performance liquid chromatography
<i>IAA</i>	Auxins
<i>KDa</i>	Killodalton
<i>LOX</i>	Lipoxygenase
<i>MAA</i>	Methacrylic acid
<i>MDA</i>	Malondialdehyde
<i>MW</i>	Molecular weight
<i>Nano</i>	Nanoparticle
<i>NFs</i>	Nanofertilizers

<b><i>NH<sub>4</sub></i></b>	Ammonium
<b><i>NO<sub>2</sub></i></b>	Nitrite
<b><i>NO<sub>3</sub></i></b>	Nitrate
<b><i>NPK</i></b>	Nitrogen, phosphorous and potassium
<b><i>NPs</i></b>	Nanoparticles
<b><i>NR</i></b>	Nitrate reductase
<b><i>PDA</i></b>	Potato dextrose agar
<b><i>POX</i></b>	Peroxidase
<b><i>PR</i></b>	Pathogenesis-related protein
<b><i>ROS</i></b>	Reactive oxygen species
<b><i>SA</i></b>	Salicylic acid
<b><i>SD</i></b>	Stander division
<b><i>SDS-PAGE</i></b>	Sodium dodecyl sulphate-polyacrylamide Sulphate gel electrophoresis
<b><i>SOD</i></b>	Superoxide dismutase
<b><i>TBA</i></b>	Thiobarbituric acid
<b><i>TCA</i></b>	Trichloro acetic acid
<b><i>TEM</i></b>	Transmission electron microscope
<b><i>TEMED</i></b>	Tetramethyl ethylenediamine
<b><i>TPP</i></b>	sodium tripolyphosphate
<b><i>TSP</i></b>	Total soluble protein
<b><i>TSS</i></b>	Total soluble sugar
<b><i>U</i></b>	Unit
<b><i>UV</i></b>	Ultraviolet
<b><i>XRD</i></b>	X-Ray Diffraction

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## Abstract

Chitosan (CS) nanoparticles loaded with nitrogen, phosphorus and potassium (NPK) were used as fertilizer and antifungal to increase the productivity of potatoes and to protect them from microbial infection. The uptake and translocation of nanoparticles inside potato plants were investigated by transmission electron microscopy. The results revealed that nanoparticles were taken up and transported through phloem tissues. Foliar application with Nano CS-NPK levels (Nano 10, 50 and 100%) significantly increased all the growth and yield parameters, photosynthetic pigments, chemical constituents of potato leaves and tubers compared with the control treatment. The highest effective treatment in this respect was 10% Nano CS-NPK as compared with bulk NPK, 50 and 100% CS-NPK.

Foliar application with 10% Nano CS-NPK stimulated potato resistance to early blight disease caused by *Alternaria solani*. Nano CS-NPK significantly reduced the severity and incidence of early blight disease in both pre and post infected treatments. Results recorded that CS-NPK nano fertilizer increased the defense related enzymes, antioxidant system, phytoalexins and plant hormones in infected plants. The