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Faculty of Science
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Biochemical Role of Some Nanoparticles to Counteract Heat Stress in Wheat

Thesis

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Declaration

I declare that, this thesis is the original work of the author and hasn't been made previously at this degree or any oth er university. It was valuable and beneficial for me and I wish to be like that for other authors and researchers.

Asmaa Abd El Kader

Contents

Subject	Page
Acknowledgement **Abstract** **List of abbreviations** **List of figures** **List of tables**	
Introduction and aim of the work	**1**
CHAPTER I	
Review of literature	**5**
I. Effect of heat stress on growth, yield and some biochemical constituents	**5**
1. Plant growth and yield	**5**
2. Biochemical constituents in wheat shoot	**9**
Lipid peroxidation product (Malondialdehyde content)	**9**
Antioxidants	**10**
Glutathione content (GSH)	**11**
Glutathione S Transferase (GST) activity	**13**
Peroxidase, catalse and superoxide dismutase isozymes	**14**

Heat shock proteins	**18**
Genetic invariability of DNA	**21**
3. Biochemical constituents in wheat grains	**21**
Combined amino acids	**21**
Minerals content	**22**
II. Effect of nanoparticles application on growth, yield and some biochemical constituents.	**22**
Nanotechnology	**22**
Types and origin of nanoparticles	**24**
Mode of entry of nanoparticles into plants	**26**
Plant growth and yield	**27**
Biochemical constituents in wheat shoot	**31**
Lipid peroxidation product (Malondialdehyde content)	**31**
Antioxidants	**33**
Glutathione content (GSH)	**33**
Glutathione S Transferase (GST) activity	**34**
Peroxidase, catalase and superoxide dismutase isozymes	**34**
Heat shock proteins	**36**
Genetic invariability of DNA	**37**
TEM analysis of nanoparticles in tissues	**39**

6. Biochemical constituents in wheat grains	**40**
Combined amino acids	**40**
Minerals content	**41**
III. Effect of salicylic acid conjugated with nanoparticles on growth, yield and some biochemical constituents	**42**
1. Plant growth and yield	**42**
2. Biochemical constituents in wheat shoot	**44**
Lipid peroxidation product (Malondialdehyde content)	**44**
Antioxidants	**46**
Glutathione content (GSH)	**46**
Glutathione S Transferase (GST) activity	**46**
Peroxidase, catalase and superoxide dismutase isozymes	**47**
Genetic invariability of DNA	**48**
Heat shock proteins	**49**
3. Biochemical constituents in wheat grains	**49**
Combined amino acids	**49**
Minerals content	**50**
CHAPTER II	
Materials and methods	**53**
I. Field experiment	**53**

II. Nanoparticles preparation and characterization	**56**
1. Copper metal nanoparticles preparation (Cu NPs)	**56**
2. ZnO nanoparticles preparation (Zn NPs)	**58**
3. Magnetite nanoparticles preparation (Fe NPs)	**59**
4. Magnetite nanoparticles conjugated with Salicylic acid preparation (SA+Fe NPs)	**60**
III. Biochemical analysis	**62**
1. Determination of moisture	**62**
2. Lipid peroxidation product (malondialdehyde content)	**64**
3. Antioxidants	**64**
3.1. Glutathione content (GSH)	**64**
3.2. Glutathione S Transferase (GST) activity	**65**
3.3. Catalase, peroxidase and superoxide dismutase by native PAGE	**67**
3.3.1. Catalase	**67**
3.3.2. Peroxidase	**71**
3.3.3. Superoxide dismutase	**75**
4. Heat shock proteins	**79**
5. Genetic invariability of DNA	**82**
6. Transmission electron microscope (TEM analysis) of	**86**

tissue nanoparticles	
7. Combined amino acids in grains	**90**
8. Minerals content	**93**
IV. Statistical analysis	**93**
CHAPTER III	
Results	**94**
Discussion	**194**
CHAPTER IV	
Summary and conclusion	**234**
References	**243**
Arabic summary	
Arabic abstract	

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Abstract

It is well known that, application of nanotechnology in the agriculture sector has promising achievements in the near future. Through that, utilization of biocompatible NPs as a new approach to counteract heat stress of wheat that might increase yield quantity and quality was used. The well designed, prepared and characterized biocompatible NPs concentrations and size were Cu NPs <50 nm (0.25, 0.50, 0.75, 1.0 and 10ppm), ZnO NPs <100 nm (0.25, 0.50, 0.75, 1.0 and 10 ppm), Fe_3O_4 <50 nm (0.50, 0.75, 1.0 and 10 ppm) and conjugation between SA (100ppm) and Fe_3O_4 <50 nm (0.25, 0.50, 0.75, 1.0 and 10 ppm) as well as tap water as a control. The NPs' treatments were applied to two wheat cultivars Sids1 (heat tolerant) and Gemmeiza7 (heat sensitive).

Two consecutive seasons were carried out during 2013/2014 and 2014/2015 at Agricultural Experimental Station of Desert Research Center (DRC) located in El Kharga Oasis, El Wadi El Gadeed Governorate in Egypt.

Results showed that all NPs treatments had positive impact on all growth traits and grain yield. Sids1 surpassed Gemmeiza7 at the quality of wheat grains (essential, non-essential amino acids and minerals content). However, Gimmeza7 exceeded Sids1 at the yield quantity especially by application of SA+Fe NPs 0.50ppm. These effects were associated with heat tolerance and the best survival in wheat cultivars. There was an increase in (glutathione content), antioxidant enzymes (Glutathione -S- Transferase, catalase, peroxidase and superoxide dismutase) and/or decline in malondialdehyde content.

Heat shock proteins were investigated, the molecular weights ranged between (19.00 to 228.0 kDa) for Sids1 cultivar, the more intensive band was (45.20 kDa for Sids1) in control and all NPs treatments but there was a destructive effect on polypeptides of Gimmeza7 cultivar due to NPs application.

Also, data reported that 16 amino acids were detected in grains including essential and non-essential amino acids. There was a marked increase in some amino acids content in Sids1 cultivar only as a result of NPs treatments but the same treatments had negative effect on Gimmeza7 amino acids which were less than control.

The ISSR technique showed that NPs caused a defragmentation to some nucleotide bases which appeared as a unique amplified fragment however; the repairing system of plant may be tolerate this slight change and compensate it.

The TEM analysis microscopy to leaves showed that some NPs with concentrations <10ppm reported less accumulation, enlargement to starch grains, increase thickness to cell walls and vacuolation phenomena. The translocation of entered NPs was clarified at micrographs (cell wall, cytoplasm, nucleus and chloroplast). Minerals content in grains at both cultivars were also investigated. It was observed that, all nanoparticles treatments increased minerals content in grains.

Our study indicated that, the treatments also increased grains' minerals especially the Zn, Ca and Fe in both cultivars.

List of abbreviations

APS	Ammonium persulphate
AF	Amplified fragment
ASA	Acetyl salicylic acid
BA2H	Benzoic acid 2 - hydroxylase.
CAT(s)	Catalase(s)
CDNB	1- Chloro-2,4- dinitrobenzene
Ch a	Chlorophyll a
Ch b	Chlorophyll b
CNT(s)	Carbon nano tube (s)
CTAB	Cetyl trimethylammonium bromide
Dr.wt	Dry weight
DLS	Dynamic light scattering
DTNB	5,5'-dithiobis nitro benzoic acid
EC	Electrical Conductivity
ENPs	Engineered nanoparticles
Fr.wt	Fresh weight
Fad	Faddan
GB	Glycine betaine
Ha	Hectare
HMW	High molecular weight
HSPs	Heat Shock Proteins
IAA	Indole Acetic Acid
ISSR	Inter simple sequence repeats
kDa	Kilo Dalton
LMW	Low molecular weight
M	Molar

MDA	Malondialdehyde
mM	Millimole
MS medium	Murashige and Skoog medium
M.wt (s)	Molecular weight (s)
NBT	Nitro blue tetrazolium
nm	Nanometer
PGR	Plant growth regulators
POD(s)	Peroxidase(s)
ppm	Part per million (mg/l)
ppb	Part per billion (µg/l)
PDI	Polydispersity index
θ	Theta
RAPD	Random amplified polymorphic DNA
ROS	Reactive oxygen species
RWC	Relative water content
SA	Salicylic acid
SDS – PAGE	Sodium dodecyl sulphate – polyacrylamide gel electrophoresis
SOD(s)	Superoxide dismutase(s)
T	Ton
TBARS	Thiobarbituric acid reactive substances
TEMED	N, N, N´, N´ - Tetramethylenediamine
TMBZ	3,3',5,5'-Tetramethylbenzidine
Tris	Tris hydroxymethyl amino methane
v/v	Volume per volume
w/v	Weight per volume
w/w	Weight per weight

List of tables

Table number	Title	Page
Table (1)	Minimum (T_{min}), optimum (T_{opt}) and maximum (T_{max}) temperatures for various reproductive phases in wheat.	**7**
Table (2)	Mechanical and chemical analysis of the experimental soil and chemical analysis of underground irrigation water at El-Wadi El-Gadeed	**51**
Table (3)	Metrological data of El Wadi El Gadeed region for two seasons 2013/2014- 2014/2015	**51**
Table (4)	Effect of Cu and Zn nanoparticles on growth traits of two wheat cultivars at first growth stage under heat stress conditions	**105**
Table (5)	Effect of Fe and SA+Fe nanoparticles on growth traits of two wheat cultivars at first growth stage under heat stress conditions	**106**
Table (6)	Effect of Cu and Zn nanoparticles on growth traits of two wheat cultivars at second growth stage under heat stress conditions	**107**
Table (7)	Effect of Fe and SA+Fe nanoparticles on growth traits of two wheat cultivars at second growth stage under heat stress conditions	**108**
Table (8)	Effect of nanoparticles on malondialdehyde content of two wheat cultivars at both growth stages under heat stress condition	**112**
Table (9)	Effect of nanoparticles on reduced glutathione (GSH) content of two wheat cultivars at both growth stages under heat stress conditions	**117**
Table (10)	Effect of nanoparticles on glutathione S transferase (GST) activity of two wheat cultivars at both growth stages under heat stress conditions	**122**
Table (11)	Effect of nanoparticles on peroxidase isozymes of Sids1 cultivar under heat stress conditions	**130**
Table (12)	Effect of nanoparticles on peroxidase isozymes of Gimmeza7 cultivar under heat stress conditions	**131**
Table (13)	Effect of nanoparticles on superoxide dismutase isozymes of Sids1 cultivar under heat stress conditions	**132**