ROLE OF SIGNAL TRANSDUCTION IN REGULATION OF GENE EXPRESSION OF DROUGHT TOLERANCE IN WHEAT

By

SARAH ADEL ABDULLAH ABD EL-BEIN
B.Sc. Agric. Sc. (Biotechnology, English section), Cairo University, 2007

A Thesis Submitted in Partial Fulfillment
Of

the Requirements for The Degree of

MASTER Of SCIENCES

in

Agricultural Sciences (Genetics)

Department of Genetics
Faculty of Agriculture
Ain Shams University

2017

ROLE OF SIGNAL TRANSDUCTION IN REGULATION OF GENE EXPRESSION OF DROUGHT TOLERANCE IN WHEAT

By

SARAH ADEL ABDULLAH ABD EL-BEIN

B.Sc. Agric. Sc. (Biotechnology, English section), Cairo University, 2007

Under the supervision of:

Dr. Eman Mahmoud Fahmy

Prof. Emeritus of Genetics, Department of Genetics, Faculty of Agriculture, Ain Shams University (Principal Supervisor).

Dr. Fatthy Mohamed Abdel-Tawab

Prof. Emeritus of Genetics, Department of Genetics, Faculty of Agriculture, Ain Shams University.

Dr. Lamyaa Mostafaa Kamal

Lecturer of Genetics, Department of Genetics, Faculty of Agriculture, Ain Shams University.

ABSTRACT

Sarah Adel Abdullah Abd El-Bein: Role of signal transduction in regulation of gene expression of drought tolerance in wheat, Unpublished Master Thesis, Department of Genetics, Faculty of Agriculture, Ain Shams University, 2017.

A Differential Display Polymerase Chain Reaction (**DD-PCR**) technique was applied for gene expression profiling to detect the up and down regulation of gene expression in shoots and roots of the two cultivars **Sahel 1**(tolerant) and **Gammeiza 7** (sensitive) in response to drought in bread wheat (***Triticum aestivum* L.**). Twenty differentially expressed ESTs fragments were obtained from shoots and roots. The sequences of ESTs were identified by using bioinformatics analysis. Seven of which were from shoots and 13 from roots. The results of fragments showed a significant homology to some predicted proteins such as: *TaAP2* which has important roles in directing changes in gene expression during stress, glycosyltransferases (*GT*s) which catalyzes the transfer of sugar moieties to a wide range of acceptor molecules, nelumbo nucifera protein NEN-4 which plays a role in cellular protection, restoration of plant functions under stress and exhibits protein-repair activity after heating to100°C, fructan 1-exohydrolase which is important for regrowth of leaf tissue after defoliation, ageratina adenophora *ICE1* protein that activates many downstream genes that confer chilling and freezing tolerance to plants. RNA polymerase II gene which regulates transcription, the synthesis of RNA from a DNA template, is one of the most important steps in control of cell growth and differentiation. Serine/threonine-protein kinase maintains unperturbed photosynthesis inducing an oxidative stress response and plays a role in salt stress signaling, *NRC-1* which is highly responsive to its environment and provided insights into some of the specific responses at the level of gene expression and prolamine genes stable proteins which is accumulated at

massive levels due to the high expression level from extensively duplicated genes in endoreduplicated cells. Elucidation of the functions of these genes can understand the signal transduction of response mechanism for drought in the two cultivars which can be used to improve the quality and productivity of Egyptian wheat in future investigations.

Key words:

Triticum aestivum, ESTs, Differential display, drought and signal transduction.

ACKNOWLEDGMENT

Firstly, I'd like to thank **my God Allah, the greatest and almighty** for give me the force and support during the master work.

I'd like to thank **Prof. Dr. Fatthy Mohamed Abdel-Tawab,** Professor Emeritus of Genetics, Genetics Dept., Fac. of Agric., Ain Shams University for designing a fantastic master plan which it's important for solving the recent and future wheat plant problem.

I'd like to thank **Prof. Dr. Eman Mahmoud Fahmy**, Professor Emeritus of Genetics, Genetics Dept., Fac. Of Agric., Ain Shams University for her kind supervision and helping me either materially or morally.

I'd like to thank the group of Biochemical Genetic Laboratory specially; Dr. **lamyaa mostafaa kamal**, lecturer of Genetics, Genetics Dept., Ain Shams University, **Shereen khaled, Heba Hassen and Marwa Mohmoud** for guiding and helping me.

I'd like to thank cytogenetics lab. "**Prof. Dr. El sayed Husseien", Professor Emeritus of** Genetics, Genetics Dept., Fac. of Agric., Ain Shams Univ. and special thanks to **Mona Moghazy.**

All thanks and greetings for Plant Pathogen Interaction Lab.(PPI) In Agricultural Genetic Engineering Research Institute (AGERI), Agricultural Research Center (ARC) with leading **Dr. Sameh El-Sayed**, Research associated Professor of Molecular Genetics for his supervisions, and his staff **Mohamed El Mahdy and Rasha Abdel Kader** for their learning and facilitating the master work.

I'd like to thank the staff of Environmental Stress Lab. (ESL), AGERI, ARC specially; **Dr. Mohamed Abdel-Sattar.**

I'd like to thank the Field Crops Research Institute, Agricultural Research Center for supplied me wheat grains.

I’d like to thank the Molecular Genetics Lab **“Pro. Dr. Mohamed Abd El-Salam”**, **Professor Emeritus of** Genetics, Genetics Dept., Fac. of Agric., Ain Shams Uni. and his group; **Prof. Dr. Mahmoud Abd-El Hafiez, Dr. Nouh Eid, Dr. Mahmoud Mossallamy, Hala Zoghly and Hager Tarek.**

Thinner salute for all **Professors of Genetics,** Department of Genetics, Faculty of Agriculture at Ain Shams University.

I’d like to thank the Central laboratory in the Faculty of Agriculture, Ain Shams University, specially; **Prof. Dr. Sayed Shaban, Dr. Sayed Abdel El-Moneam, Dr. Manal Moubarek and Dr. Ashraf.**

Special thanks to the Academy of Scientific Research and its contribution to the support of this thesis.

I cann’t express my feels to thank my parents and my brother to enhance and encourage me.

Special thanks for new freinds which I acquired them, specially the soul of **Asmaa Hamed**.

Finally, I cann’t find nothing wrong to thank Myself which posses patience, calm self and faith in **God** for illogic reasons, thanks **Sarah Adel.**

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ABA	Abscisic acid
AP	Arbitrary primers
APS	Ammonium persulfate
ATI	Abiotic tolerance index
AWC	Available water content
BAC	Bacterial artificial chromosome
Blast	Basic local alignment search tool
Blastn	Basic local alignment search tool nucleotide
Blastp	Basic local alignment search tool protein
Blastx	Basic local alignment search tool nucleotide to protein
bZIP	Basic Leucine Zipper Domain
cDNA	Complementary DNA
CDNA-AFLP	Complementary DNA amplified fragment length polymorphism
COR	Cold-stress-responsive
CVG	Germination and coefficient of velocity
DD	Differential display
DI	Drought resistance index
DREB	DRE binding proteins
DRI	Drought response index
EDTA	Ethylenediaminetetraacetic acid
EST	Expressed sequence taq
EtBr	Ethedium bromide
E-value	Expected value
FEH	Fructan 1- exohydrolase
G7	Gemmeiza 7
GAD	Glutamic Acid Decarboxylase
Glu/Gli	The glutenin-to-gliadin ratio
GMP	Geometric mean productivity
GST	Glutathione-s-transferase
GT	Glycosyltransferase
HEG	High K utilization efficiency cotton genotype
HSPs	Heat shock proteins
ICE1	Inducer of CBF expression 1
KUE	Potassium utilization efficiency