



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكرو فيلم

بسم الله الرحمن الرحيم



MONA MAGHRABY



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التوثيق الإلكتروني والميكروفيلم



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



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جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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GENETICAL AND PHYSIOLOGICAL ANALYSIS OF HEAT TOLERANCE IN BREAD WHEAT

By

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B.Sc. Agric. Sci. (Agronomy), Fac. Agric., Assiut Univ., 2005

M.Sc. Agric. Sci. (Genetics), Fac. Agric., Cairo Univ., 2012

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ABSTRACT

Frequent episodes of heat threaten sustainable agriculture in Egypt. Here, twenty spring wheat genotypes were exposed to heat stress under field conditions for screening heat tolerance. Stress environments were simulated by delaying the sowing date by 53 and 58 days than the normal environments for two successive seasons. Eight phenotypic parameters were measured to evaluate genotype tolerance. Mean performance, reduction percentage/trait, and heat susceptibility index were calculated. Additionally, the pollen grains viability during spike emergence and the germinability of produced grains were investigated. The molecular tolerance mechanism was studied by investigating the expression of nine heat-responsive genes. Results demonstrated: (1) A significant reduction was observed in all studied traits compared to the non-stress environment, (2) the overall yield reduction, based on grain yield/m², was 40.17, 41.19% in the first and second seasons, respectively, and the most tolerant genotypes were Misr2, Sids1, Giza171 and Line9, (3) limited impact of heat was detected on pollen grains viability and germinability, and (4) grain yield as a selection criterion for heat stress remains the most reliable yardstick. Thereafter, the most tolerant (Misr2) and one of the most susceptible (Line4) genotypes have been chosen to study the genetical and physiological mechanisms of heat tolerance. The most tolerant and the most susceptible genotypes were sown in the third season, using the same procedure to stimulate heat stress. Samples were collected at 7 days after anthesis (DAA). Physiological studies revealed changes in all studied physiological traits in response to heat stress. The tolerant genotype showed increases in photosynthetic pigments, proline, total soluble sugars and all studied antioxidant enzymes, comparing with susceptible genotype. For the first time, we measured the peroxisome abundance under stress condition relative to normal one, in the most tolerant and most susceptible genotypes and found that the peroxisome abundance was increased under stress condition, especially in the tolerant genotype. The molecular data revealed changes in the gene products in all studied heat shock proteins (HSP70, HSP90 and HSP101), genes encoded the antioxidant enzymes (SOD and CAT) and some of peroxisomal proliferation genes due to heat stress. The tolerant genotype (Misr2) could enhance the transcription levels of several genes (HSP70, HSP90, HSP101, CAT and PEX11.4), which is considered as a main tolerance mechanism. On the other hand, the susceptible genotype also enhanced the transcription levels in HSP70 and CAT genes, but in a lower rate, as well as SOD and DRP5B, comparing with the normal environment. It could be concluded that the tolerant genotype possesses different ways to withstand heat stress; such as increasing the expression of some heat-responsive genes, increasing in the production of osmoprotectants, increasing in the activities of antioxidant enzymes defense system and more peroxisome abundance which allowed Misr2 to tolerate the negative impact of heat stress. While the susceptible genotype (Line4) showed some of these defense mechanisms but to a lesser extent which finally visualized in low yield and bad performance under stress conditions.

Keywords: Bread wheat, Heat stress, Field evaluation, Reproductive stage, Heat susceptibility index, Gene expression, Physiological analysis, peroxisomes.

DEDICATION

I dedicate this work to my dear mother's soul who left before ending it, as she was a source of strength and constant encouragement. I would like to take this opportunity to acknowledge her support lovely offered during my life.

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LIST OF ABBREVIATIONS

ROS	Reactive Oxygen Species
HRI	Heat Response Index
STI	Stress Tolerance Index
HSI	Heat Susceptibility Index
SAGs/SAPs	Stress-Associated Genes/ Proteins
HSPs	Heat Shock Proteins
CAT	Catalase
SOD	Superoxide Dismutase
HS	Heat Stress
DAA	Days After Anthesis
DAS	Days After Sowing
MAS	Marker Assisted Selection
CFL	Chlorophyll Florescence
<i>Chl</i>	Chlorophyll Content
S1	Season 1
S2	Season 2
NE	Normal Environment
SE	Stress Environment
EMA	Egyptian Meteorological Authority
PCA	Principle Component Analysis

DTT	Dithiothreitol
TSS	Total Soluble Sugars
MDA	Malondialdehyde
TCA	Trichloroacetic Acid
TBA	Thiobarbituric Acid
POX	Peroxidase
DTH	Days to Heading
DTM	Days to Maturity
GFD	Grain Filling Duration
PH	Plant Height
SL	Spike Length
SNO	Number of Spikes/m²
GY/m²	Grain Yield/m²
PEX	Peroxin
FIS	Mitochondrial Fission 1
DRP	Dynamin-Related Protein

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