Genetic and Physiological Effects of Ultraviolet Radiation on Tomato Plant (*Solanum lycopersicum)*

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Biophysics

By

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bP	base pair
CAT	Tomato catalase enzyme
CAT	Tomato catalase gene
Car	Carotenoids
cDNA	Complementary Deoxyribonucleic Acids
CFCs	Chlorofluorocarbon
Chl a	Chlorophyll a
Chl b	Chlorophyll b
CPD	Cyclobutane pyrimidine dimer
GST	Glutathione S-transferase
PCR	Polymerase chain reaction
POX	Peroxidase enzyme
ROS	Reactive oxygen species
RT-PCR	Reverse transcriptase polymerase chain reaction
SOD	Superoxide dismutase enzyme
TPX1	Tomato peroxidase gene
UV-A	Ultraviolet A
UV-B	Ultraviolet B
UV-C	Ultraviolet C
[6–4]-PP	Pyrimidine-(6–4)-pyrimidone photoproduct

ABSTRACT

A depletion of the ozone layer due to emissions of chlorofluorocarbons CFCs of anthropogenic origin during the past few decades. This depletion causes an increase in solar Ultraviolet-B (UV-B) radiation. High levels of UV-B have numerous biological harmful effects on human, plants and animals. Therefore, there is a real interest in a well understanding of the tools set by the plants to respond to this stress. The aim of present work is to study the physiological and genetic effects in Tomato Plant *Solanum lycopersicum* due to UV-A exposure by doses 9, 18 and 35 kJ/m^2 and also UV-B exposure by doses 6, 12 and 24 kJ/m^2. The experimental work and measurements were carried out using biophysical and biochemical techniques: spectrophotometer, electrophoresis, PCR and Mat lab

The results of physiological study show that:

- A maximum decrease in Chl b and carotenoids was about 30% , while the maximum decrease in Chl a was about 40% at exposure dose 35 kJ/m^2 of UV-A in relative to the control values.
- The effect of UV-B on the pigments was more harmful to Chl a which decreased by 46% at dose 24 kJ/m^2.
- In general exposure of plant leaves to both UV-A and UV-B caused a noticeable decrease in the activity of defense system enzyme (antioxidants).
- A decrease in the activity of CAT enzyme by 35% at dose 18 kJ/m^2 of UV-A while the more energetic UV-B caused a decrease its activity to 48% at 24 kJ/m^2.
- The peroxidase activity was decreased by about 70 % for 35 kJ/m^2 UV-A compared with 67% for 24 kJ/m^2 of UV-B.

The results of genetic study show that:

- Up-regulation of *CAT* (catalase) gene expression, while a down-regulation of *TPX1* in response to UV-A and UV-B irradiation.
- The estimated amount of *CAT* gene expression gained a high value at a dose 24 kJ/m^2 of UV-B with a percentage of increase 160%.
- The estimated amount of *CAT* gene expression gained a high value at a dose 35 kJ/m^2 of UV-A with a percentage of increase 60%.
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- The harmful effect of UV on *TPX1* (tomato peroxidase gene) was clearly appear at low level doses of UV
- At higher doses of UV-A (35 kJ/m^2) *TPX1* was down-regulated by 50%
- UV-B by a dose 24 kJ/m^2 created *TPX1* down regulation by 90%

The obtained results may be considered as a base for understanding the mechanism or mechanisms underlying the physiological and genetic changes due to exposure of plants to increased level of solar UV. On the other hand, it may be useful to persons who studying or researching in the field of climate and environmental work.

Key words: UV-A, UV-B, *TPX1*, *CAT*, Tomato plant Solanum *lycopersicum*, and PCR.