Faculty of Science

Physiological studies on *Ocimum basilicum* L. plants as affected by gamma radiation, glycine betaine and salinity stress.

A Thesis
Submitted for Partial Fulfillment of
Master Degree of Science in Botany
(Plant Physiology)

By
Yousra Elsayed Hassan Elsayed
B.Sc. in Science (Botany)
(2001)

Ain Shams University
Faculty of Science
Botany Department
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Yousra Elsayed Hassan Elsayed

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ABSTRACT

Name: Yousra Elsayed Hassan Elsayed

Title: " Physiological studies of *Ocimum basilicum* L. plants as affected by gamma radiation, glycine betaine and salinity stress "

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The experiments in the present investigation were carried out in 2 successive seasons during 2005 and 2006 to study the effect of two salinity levels (75 and 150 mM NaCl), irradiation of seeds with 20 Gy or foliar treatment with 100 mM glycine betaine (GB) or their interaction on growth vigor ,yield ,endogenous phytohormones (IAA, GA_3 and ABA), photosynthetic pigments, carbohydrate contents, nitrogen constituents, certain mineral ion contents (Na^+, K^+, Mg^{++}, Ca^{++} and Na/K ratio), some antioxidant compounds (proline, anthocyanins and total phenols), lipid percentage and fatty acid composition , volatile oil contents and volatile oil composition of leaves of sweet basil plant at flowering stage.

The result cleared that treatment with the 2 levels of NaCl significantly decreased the growth and consequently the yield of sweet basil plant, this inhibition was positively correlated to the applied concentration of salinity. The inhibition of growth in the salinity stressed sweet basil plant was accompanied by decreases in the phytohormone levels (IAA, GA_3) photosynthetic pigments, carbohydrate contents ,nitrogen constituents, K, Mg, Ca ions content and increases in ABA content, Na ions level, the antioxidant compounds (proline, anthocyanins and total phenols) total volatile oil

particularly, linalool, methyl chavicol, eugenol and β-caryophyelene. Therefore salinity was shown to improve quality of volatile oil, since eugenol is an antioxidant compound. Also salinity stress decreased the percentages of saturated fatty acids and increased the percentages of the unsaturated ones (oleic, linoleic and linoleic which are know omega 3).

Application of gamma radiation, GB or their interaction could alleviate the adverse effect of salinity by stimulating the growth and yield of sweet basil plant. This stimulation in growth was accompanied by increases in IAA, GA_3, photosynthetic pigments, carbohydrate contents, nitrogen constituents, K^+, Mg^{++}, and Ca^{++} ions contents, additional increases in antioxidant compounds; proline, anthocynins & total phenols, omega 3 fatty acids and decreases in Na ion content and ABA level.

Key works:

Sweet basil – *Ocimum basilicum* L. – gamma radiation - glycine betaine (GB) - fatty acids – volatile oils – proline – anthocyanins – total phenols.

LIST OF ABBREVIATIONS

Abb.	Complete name
GB	Glycine betain
GY	Gray
GC	Gas chromatography
GC-MS	Gas chromatography-Mass spectrometry analysis
IAA	Indole acetic acid
ABA	Abscisic acid
GA_3	Gibberllic acid
TSN	Total soluble nitrogen
BHT	Butylated hydroxyl toluene
ADP	Adenosine 5-diphosphate

INTRODUCTION

Salinity is a major environmental stress and is a substantial constraint to crop production. Increased salinization of arable land is expected to have devastating global effects, resulting in 30% land loss within next 25 years and up to 50% by the middle of 21st century **(Wang *et al*., 2003**). High salinity causes both hyperionic and hyperosmotic stress and can lead to plant demise **(Mahajan and Tuteja, 2005)**. In the arid and semi-arid parts of Africa, for instance, salinity and alkalinity are major problem affecting about 24% of the continent **(Reich *et al*., 2001)**.

Gamma irradiation has been widely applied in medicine and biology in terms of biological effects induced by accouter intuitive switch over from low dose simulation and high dose inhibition. Pervious studies have shown that relatively low dose ionizing radiation on plants and photosynthetic microorganisms are manifested as accelerated cell proliferation, germination rate, cell growth, enzyme activity, stress resistance and crop yields **(Baek *et al*., 2005; Kim *et al*., 2005).**

Among many quaternary ammonium compounds known in plants, glycine betaine (GB) occurs most abundantly in response to water stress **(Venkatesan and Chellappan, 1998; Mansour, 2000; Mohanty *et al*., 2002; Yang *et al*., 2003).** GB is abundant mainly in chloroplast where it plays a vital role in