

**EFFECT OF GAMMA RAY TREATMENTS ON
FABA BEAN AND ITS TOLERANCE TO
SALINITY AND ASSESSMENT OF GENOTYPES
VIA MOLECULAR TECHNIQUES**

By

HUDA AHMED ABDEL-SALAM

B.Sc. Agric. Sci. (Agronomy), Fac. Agric., Cairo Univ., 2010

THESIS

**Submitted in Partial Fulfillment of the
Requirements for the Degree of**

MASTER OF SCIENCE

In

**Agricultural Sciences
(Agronomy)**

**Department of Agronomy
Faculty of Agriculture
Cairo University
EGYPT**

2017

SUPERVISION SHEET

**EFFECT OF GAMMA RAY TREATMENTS ON
FABA BEAN AND ITS TOLERANCE TO
SALINITY AND ASSESSMENT OF GENOTYPES
VIA MOLECULAR TECHNIQUES**

**M.Sc. Thesis
In
Agric. Sci. (Agronomy)**

By

HUDA AHMED ABDEL-SALAM
B.Sc. Agric. Sci., (Agronomy), Fac. Agric., Cairo Univ., Egypt, 2010

SUPERVISION COMMITTEE

Dr. MAZHAR MOHAMED FAWZI ABDALLA
Professor of Agronomy, Fac. Agric., Cairo University

Dr. EMAN ABD-ELLATIF MOHAMMED
Associate Professor of Agronomy, Fac. Agric., Cairo University

Dr. CLARA REDA AZZAM
Head Researcher, Cell Res. Dep., Field Crops Res. Inst., ARC

Name of Candidate: Huda Ahmed Abdel-Salam **Degree:** M.Sc.
Title of Thesis: Effect of Gamma Ray Treatments on Faba Bean and its tolerance to Salinity and Assessment of Genotypes *via* Molecular Techniques
Supervisors: Dr. Mazhar Mohamed Fawzi Abdalla
Dr. Eman Abd-Ellatif Mohammed
Dr. Clara Reda Azzam
Department: Agronomy **Branch:**
Approval: 11 / 9 / 2017

ABSTRACT

This study was carried out during 2011- 2015 in the field, greenhouse, and laboratories of Field Crops Research Institute (FCRI), Agricultural Research Center (ARC), Giza, Egypt, to study the effect of gamma irradiation doses (0, 25, 50, 75, 100 Gy) on four varieties of faba bean (Cairo 33, Giza 843, Sakha 2, Nubaria 1) and the response of the four faba bean varieties and the genotypes which developed from its M2 generation to salt tolerance by using five NaCl solution concentrations (0 - 50 - 75 - 100 - 150 mM) in four experiments. The work aimed to increase genetic variations in four cultivars of faba bean by gamma-ray and selection of the genetic compositions tolerant to salinity. Identifying the genetic variations among the used varieties and the newly developed salt-tolerant genotypes produced by gamma irradiation using RAPD and ISSR banding patterns. The higher doses of gamma irradiation decreased plant height at 35 DAS except for Giza843 and plant height at harvest but showed slight increase in number of branches plant⁻¹ and dry weight plant⁻¹ except for Cairo33 variety also, number of pods plant⁻¹ and number of seeds⁻¹ increased in Cairo33 and Giza843 than other two varieties. Weight of seeds plant⁻¹ decreased in Cairo33 and Nubaria1 varieties but increased in Giza843 and Sakha2 varieties. Seed index decreased generally except Nubaria 1 and Giza843 varieties. The results indicated that all the traits under study were significantly decreased by increasing the NaCl concentration up to 100 mM concentration with a sharp decline at a concentration of 150 mM. A genotype tolerant to salinity was found (dose 50 Gy on Nubaria 1) and characterized by ISSR primer UBC 827. The molecular characterization of the four faba bean varieties and their newly developed salt-tolerant genotypes were performed using RAPD and ISSR analysis.

Key words: Faba bean, *Vicia faba*, genotype, gamma ray, salinity tolerance, NaCl, ISSR, RAPD.

DEDICATION

I dedicate this work and heartfelt thanks to my Family to help and all the support they lovely offered during my life and my study and my work, for everything they offered to me especially prof. Dr. Naglaa Ashry and prof. Dr. Mohamed El-Nabawy A.R.C for continued assistance. Thanks for prof. Dr. Ramadan Harb professor of Botany, Faculty of Agriculture, Cairo University for his supported and guidance.

ACKNOWLEDGEMENTS

*Thanks to Allah, the most Merciful and the most Beneficial. I wish to express my sincere thanks, deepest gratitude and appreciation to **prof. Dr. Mazhar Mohamed Fawzi Abdalla** who my teacher and leader Professor of Agronomy, Faculty of Agriculture, Cairo University, **Dr. Eman Abd Ellatif Mohamed** associate professor of Agronomy, Faculty of Agriculture, Cairo University and **prof. Dr. Clara Reda Azzam** Head Researcher, Cell Res. Dep. Field Crops Research Institute, A.R.C for suggesting the problem, supervision and revision the manuscript of this thesis. Sincere appreciation is also extended to **prof. Dr. Wafaa El-Eter** who helped me for enforcement the saltinity experiments, Thanks for **Dr. Rehab Ahmed Abd Alrahman** Field Crops Research Institute, A.R.C for seed samples multiplication.*

CONTENTS

	Page
INTRODUCTION	1
REVIEW OF LITERATURE	5
1. Gamma rays mutagens and induction of genetic variation.....	5
2. Effect of salinity and breeding faba bean for salt tolerantce.....	9
3. Molecular markers associated with salt tolerance.....	16
MATERIALS AND METHODS	23
1. Plant materials.....	1
2. Methods.....	24
a. Effect of gamma ray radiation on some growth and yield characteristics of M1 faba bean generation in season 2011-2012.....	24
b. Effect of salinity concentrations on some seedling characteristics of the four faba bean varieties (pot experiment), season 2012-2013.....	26
c. Effect of salinity concentrations on M2 faba bean generation on some seedling characteristics at season 2012-2013.....	27
d. Effect of salinity concentrations on M2 faba bean generation on some seedling and yield characteristics season 2013-2014.....	28
e. Molecular characterization.....	30
RESULTS AND DISCUSSION	37
1. Effect of gamma ray radiation on some growth and yield characteristics of M1 faba bean 2011-2012.....	37
2. Effect of salinity concentrations on some seedling characteristics of the four faba bean varieties at season 2011-2012.....	41
3. Effect of salinity concentrations on M2 faba bean generation on some seedling characteristics at season 2012-2013.....	43
4. Effect of salinity concentrations on M2 faba bean generation on some seedling and yield characteristics at season 2013-2014.....	47
5. Molecular analysis.....	63
SUMMARY	89

CONTENTS (continued)

REFERENCES..... 101

ARABIC SUMMARY

INTRODUCTION

Faba bean (*Vicia faba* L.) is one of the ancient cultivated crops widely believed to have originated in the Mediterranean-West Asia region (Tanno and Willcox, 2006 and Tavakkoli *et al.*, 2012) and/or Egypt (Abdalla 1969). It is one of the cultivated species of the family fabaceae (Bulut and Akinci, 2010). Its seeds are consumed dry, fresh, frozen or canned (Duc *et al*, 2010). Leguminous plants are important sources of proteins, vitamins, carbohydrates, fibers and minerals (Lima *et al*, 2011). Faba bean also contributes to farmer's income and improves the soil fertility through biological nitrogen fixation (Duc, 1997 and Mejri *et al*, 2012).

Mediterranean regions are currently experiencing increasing salt stress problems resulting from seawater intrusion into aquifers and irrigation with brackish water (Rana and Katerji, 2000). The primary value of increasing the salt tolerance of crops will be to the sustainability of irrigation (Flowers, 2004). Most crops tolerate salinity to a threshold level above which yields decrease as salinity increases (Swalem, 2000 and Kafi and Goldani, 2001). Cool season food legumes are sensitive to salinity (Saxena *et al*, 1993). Faba bean plants are more sensitive to water stress than other grain leguminous species (McDonald and Paulsen, 1997; Amede and Schubert, 2003 and Khan *et al*, 2010).

A major aim for any crop breeding program is the development of good quality lines with an adequate resistance/tolerance to yield-