EFFECT OF GAMMA RAYS ON MUTATION INDUCTION IN RICE

By

SOBHY ATTALAH AZER

A thesis submitted in partial fulfillment

of

the requirements for the degree of

DOCTOR OF PHILOSOPHY

in

Agricultural Science

(Field Crops)

Department of Agronomy

Faculty of Agriculture

Ain Shams University

1990

Approval Sheet

EFFECT OF GAMMA RAYS ON MUTATION INDUCTION IN RICE

By

SOBHY ATTALAH AZER

B.Sc. (Agric.), Cairo University, 1973

M.Sc. (Agric.), Ain Shams University, 1982

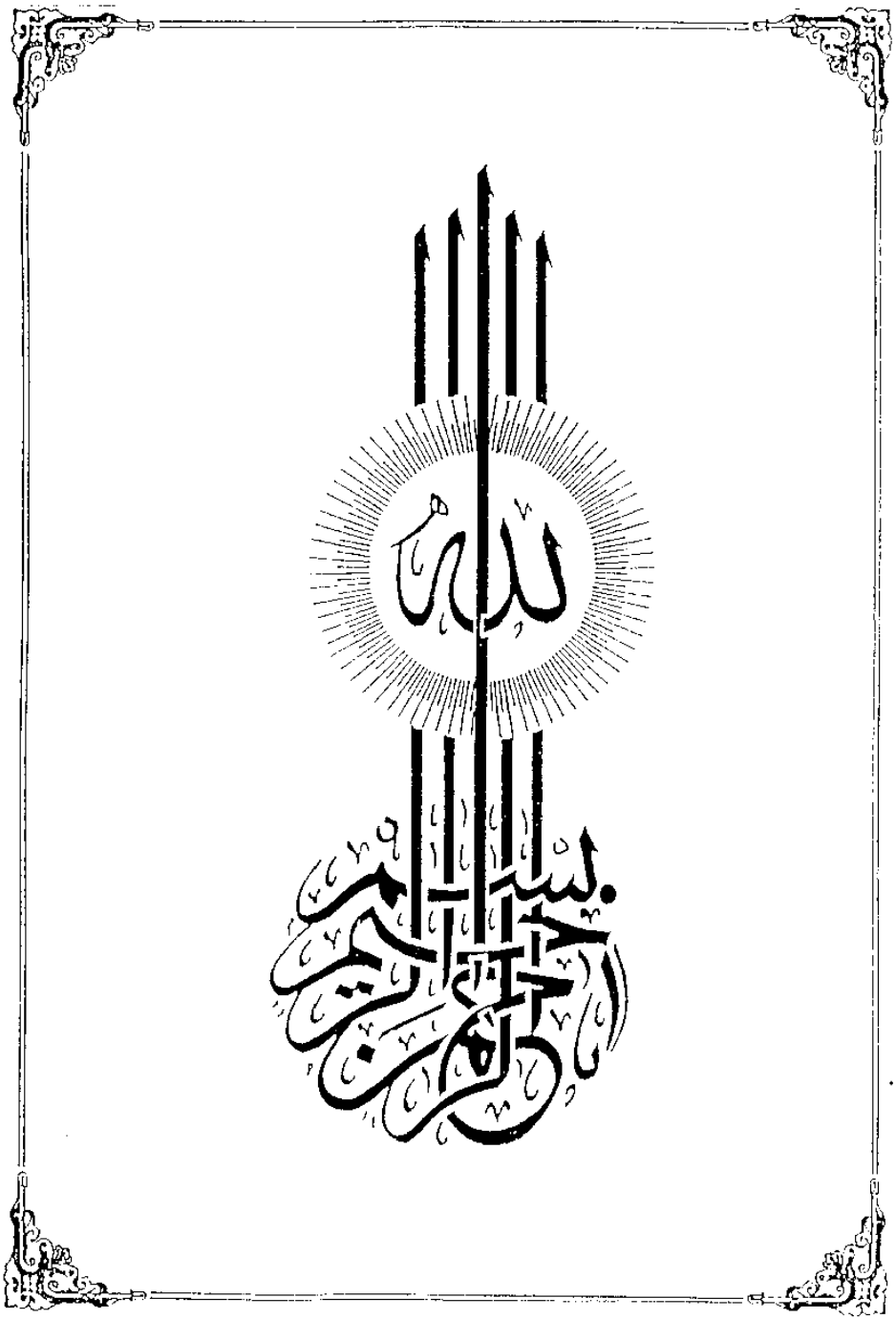
this thesis for Ph.D. degree has been approved by:

Prof. Dr. A.H. Salem.
Prof. of Agronomy, Univ. of Zagazig

Prof. Dr. A.M. El-Marakby.
Prof. of Agronomy, Univ. of Ain Shams

Prof. Dr. K.A. El-Shouny.
Prof. of Agronomy, Univ. of Ain Shams

Date of examination: 19/ 6/1990



EFFECT OF GAMMA RAYS ON MUTATION INDUCTION IN RICE

By

SOBHY ATTALAH AZER

B.Sc. (Agric.), Cairo University, 1973

M.Sc. (Agric.), Ain Shams University, 1982

Under the supervision of: Prof. Dr. K.A. El-Shouny

Prof. of Agronomy, Ain Shams Univ.,

Dr. A.A. Mohamed.

Assistant Prof. of Agronomy, Ain Shams Univ.,

ABSTRACT

Two local rice varieties, Giza 180 (Indica) and Giza 172 (Japonica) were irradiated with 15, 25 and 35 krad of gamma rays for inducing useful mutations in rice. 25 changed forms were isolated in M_2 generation on the basis of earliness, short stature and panicle and grain characteristics. In M_3 generation, six promising macro mutant types were selected, five derived from the irradiated populations of the variety, Giza 180 and one from the variety, Giza 172. Thirty three mutant lines, representing the six mutant types were chosen and evaluated in M_4 and M_5 generations. In M_6 generation only 13 promising mutant lines were evaluated under salinity and water stress conditions.

Results revealed that, all mutant types derived from the variety Giza 180 headed earlier by about 9-21 days, whereas the mutant type (172-7) derived from the variety, Giza 172

headed later by 7 days from their parents. Significant decrease was found in most studied traits, except significant increase was detected in number of spikelets per panicle and panicle density in the mutant 180-1-14 and in no. of productive tillers per plant in the mutant line, 180-5-4. Meanwhile, the mutant lines, 180-1-20, 180-6A-10, 180-7-7, 172-7-4, 172-7-8 and 172-7-9 did not significantly differ in grain yield from its respective variety. Protein content decreased in all mutant lines, except the mutant line, 180-1-8, which equalled the original variety, Giza 180. Meantime, significant increase in amylose content by about 2-3% over the variety, Giza 180, was obtained in mutant lines; 180-1-11, 180-1-13, 180-5-4, 180-7-1 and 180-7-7, while significant decrease was found in the three mutant lines derived from the variety, Giza 172.

Results of salinity and water stress experiments, indicated that, the mutant lines, 180-1-14; 180-7-2 and 180-7-7 were more tolerant under 2000 ppm. added salt treatment, meanwhile, the two mutant lines, 180-1-3 and 180-1-14 were moderately tolerant under 4000 ppm. added salt treatment. Under 6000 ppm. added salt the mutant line, 180-1-14 was moderately susceptible. However, mutant lines, 180-6-4, 180-6-6 and 180-6-7 were more tolerant under 6 days irrigation interval treatment, meantime the mutant line, 180-6-6 was moderately tolerant under mine days irrigation interval treatment.

ACKNOWLEDGMENT

I wish to express my great appreciation and gratitude to Prof. Dr. K.A. El-Shouny, Professor. of Agronomy, Faculty of Agric., Ain Shams Univ., for suggesting the problem, drawing the plan of the work, useful help, and encouragement during the course of this study and the preparation of this thesis.

Sincere appreciation and gratitude are expressed, in particular, to Dr.A.A. Mohamed, Assistant Professor. in Agronomy department Faculty of Agric., Ain Shams Univ., for his supervision, valuable guidance, useful help during the preparation of the manuscript.

Thanks are due to Prof. Dr. M.T.M. Sharabash, Professor. of Agronomy and head of plant production and insects Dept., National Center for Radiation Research and Technology, Nasr City Cairo, for his valuable assistance, and providing facilities during this work.

Sincere thanks and gratitude are also due to Dr. K.I. Mohamed, Lecturer in Agronomy Department, Faculty of Agric., Ain Shams Univ., for his kind help in connection with the statistical analysis.

CONTENTS

LIST OF TABLES

List of plates.

INTRODUCTION

Rice (Oryza sativa L.) is one of the most important cereal crop in Egypt. Introducing varieties of rice characterized by early heading, short stature, lodging resistance, and improved panicles and grain characters are main objectives for vertical increase of grain yield of rice.

It is already known that radiation treatments offers a fairly good chance for obtaining favourable genetic changes in an established variety in a reasonably short time than the usual hybridization methods as reported by Kawai (1968) and Ree(1971).

The aim of this work was to improve the agronomical traits of two local rice varieties, Giza 180 (Indica) and Giza 172 (Japonica) by exposure the air dried dormant seeds to different dosages of gamma rays before sowing, as well as studying and evaluating the induced mutations for protein and amylose content and its yielding ability when they are grown under salinity and water stress conditions.

REVIEW OF LITERATURE

A. Induction of mutations.

A.1. Mutations of altered heading date.

A.1.1. Early heading mutations.

Earliness in heading is considered to be an important aim in rice breeding programs under distinct ecological conditions. This trait can be obtained reliably through mutation breeding. Therefore, several early heading mutants has been selected in rice after treating seeds with different physical or chemical mutagenesis. For instance, Miah and Bhatti (1968) selected six plants in M_2 generation as early flowering mutant types (3 from 35 krad, 2 from 40 Krad and one from 45 Krad) from treated populations of rice variety "kangni -27" with gamma rays. These mutants came to heading about 3-6 days earlier than the control. However, results of M_3 generation evident that all these selections came also to heading earlier than the control, except one, and the earliest mutant came to flowering 11 days earlier than the parental variety.

Tanaka (1968) isolated number of mutant lines induced in rice plants in M_3 generation by cronic exposure to gamma rays. The earliest mutant line showed panicle emergence sixty days earlier than that of the mother variety. The isolated mutants were dwarf with reduced number of leaves.