

# **GENETICAL STUDIES ON SOME HEXAPLOID WHEAT VARIETIES AND THEIR HYBRIDS**

**By**

**JOSEPH ELIA NASSEEF**

**B.Sc. Agric. Sci. (Agronomy), Fac. Agric., Assiut Univ., ٢٠٠٥  
Completing the Genetics Department Requirements, Fac. Agric., Ain  
Shams Univ., ٢٠٠٨**

**THESIS**

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

**MASTER OF SCIENCE**

**In**

**Agricultural Sciences  
(Genetics)**

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

**٢٠١٢**

**APPROVAL SHEET**

**GENETICAL STUDIES ON SOME HEXAPLOID  
WHEAT VARIETIES AND THEIR HYBRIDS**

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

**By**

**JOSEPH ELIA NASSEEF**

**B.Sc. Agric. Sci. (Agronomy), Fac. Agric., Assiut Univ., ٢٠٠٥  
Completing the Genetics Department Requirements, Fac. Agric., Ain  
Shams Univ., ٢٠٠٨**

**APPROVAL COMMITTEE**

**Dr. Said Abd-El Salam Dora.....**  
**Professor of Genetics, Fac. Agric., Kafr El-Sheikh University**

**Dr.Abd-El Kader Youssef Gamal El-Deen.....**  
**Professor of Genetics, Fac. Agric., Cairo University**

**Dr.Mona Hashem Ahmed Hussein.....**  
**Professor of Genetics, Fac. Agric., Cairo University**

**Date: ٢٧/٠٦/٢٠١٢**

**SUPERVISION SHEET**

**GENETICAL STUDIES ON SOME HEXAPLOID  
WHEAT VARIETIES AND THEIR HYBRIDS**

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

**By**

**JOSEPH ELIA NASSEEF**

**B.Sc. Agric. Sci. (Agronomy), Fac. Agric., Assiut Univ., ٢٠٠٥  
Completing the Genetics department Requirements, Fac. Agric., Ain Shams Univ.,  
٢٠٠٨**

**SUPERVISION COMMITTEE**

**Dr. MONA HASHEM AHMED HUSSEIN**  
**Professor of Genetics, Fac. Agric., Cairo University**

**Dr. BASITA ABBAS HUSSEIN**  
**Lecturer of Genetics, Fac. Agric., Cairo University**

**Dr. AIDA ALFONSE RIZKALLA**  
**Associate researcher Professor of Plant Genetics, National Research  
Center**

**Name of Candidate:** Joseph Elia Nasseef **Degree:** M.Sc.  
**Title of Thesis:** Genetical Studies on Some Hexaploid Wheat Varieties  
and Their Hybrids.  
**Supervisors:** Dr. Mona Hashem Ahmed Hussein  
Dr. Basita Abbas Hussein  
Dr. Aida Alfonse Rizkalla  
**Department:** Genetics **Approval:** ٢٧/٠٦/٢٠١٢

### ABSTRACT

Combining ability and heterosis were studied in a  $V \times V$  diallel set of bread wheat. Analysis of variance revealed that mean squares due to genotypes, parents and  $F_1$  crosses, were highly significant for all studied characters. The mean square due to parents vs. crosses, as an indication to the average heterosis, found to be highly significant for all studied traits. Also, the mean squares due to both general (GCA) and specific (SCA) combining abilities were highly significant for all studied characters. Significant and highly significant desirable heterosis relative to the better parent was recorded in all studied characters. The maximum useful heterosis (٧٨.٠%) was observed in grain yield/plant for cross ( $P_4 \times P_7$ ). Many hybrids showed desirable significant or highly significant specific combining ability effects for all studied traits, except days to ٥٠% heading and plant height. The relationship among the seven parental genotypes was investigated using ١٠ RAPD primers. The highest similarity index was found between  $P_5$  and  $P_7$ , while the lowest similarity index was found between  $P_7$  and  $P_1$ . Among the studied parents, five out of seven parents were characterized by ١٣ negative and ٧ positive unique markers. According to the presence or absence of bands in each hybrid, the RAPD markers were classified into seven types of markers included in three categories. The bands common in the two parents and their hybrid (Type ١), bands common in hybrid and its female parent (Type ٣) or its male parent (Type ٤), these three types of markers are belonging to category ١. The bands from parents not found in hybrid and included in markers type ٢, ٥ and ٦ (category ٢). The third category are non-parental bands expressed uniquely in hybrid and included in marker type ٧. Results showed that the percentages of each category differed among the studied hybrids. Non-significant correlations were observed between genetic distance with each of heterosis and specific combining ability for grain yield / plant, as well as between heterosis and specific combining ability.

**Keywords:** Bread wheat, hybrids ,combining ability ,heterosis, DNA, unique marker, RAPD, similarity index.

## *DEDICATION*

*I dedicate this work to my mother, father, brothers and my friends for all the support they lovely offered during my Master studies.*

*Also, I dedicate this work to Prof. Dr. Aida Alfonse Rezkalla and to my love.*

## **ACKNOWLEDGEMENTs**

*Unlimited thanks for Jesus, on his uncountable and infinite graces, guided me to complete this work.*

*I would like to express my sincere gratitude, special thanks and appreciation to **Dr. Mona H. A. Hussein**, Professor of Genetics and **Dr. Basita A. Hussein**, Lecturer of Genetics, Cairo university, member of supervision committee for kind guidance, valuable advices, continuous encouragement, sincere concern and accurate supervision throughout all stages of my M. Sc. Work and during the preparation of this manuscript.*

*Sincere thanks and grateful appreciations are extended to **Dr. Aida A. Rizkalla**, Associate professor of genetics and member of the supervision committee for her valuable guidance, inspiring help, infinite efforts and sincere concern*

*Also I would like to express my sincere gratitude, special thanks and appreciation to **Dr. Abd-El-Rahman M. F. Al-Ansary** Associate professor of genetics, National Research Center and member of the supervision committee and **Dr. Elham A. Abbas** professor of genetics, National Research Center for their inspiring help, devoted efforts during the preparation of this thesis.*

*Also I would like to express my special thanks to **Dr. Mohamed A. El-Morshedy** for kindly providing the genotypes used in this work.*



# CONTENTS

	Page
<b>INTRODUCTION</b> .....	۱۵
<b>REVIEW OF LITERATURE</b> .....	۱۸
۱. Diallel analysis of wheat characters.....	۱۸
۲. Random amplified polymorphic DNA (RAPD).....	۲۵
۳. Characterization of hybrids by RAPD marker.....	۲۹
۴. The relation between RAPD marker and hybrid performance.....	۳۰
<b>MATERIALS AND METHODS</b> .....	۳۴
۱. Plant material.....	۳۴
۲. Field experiments.....	۳۵
۳. Biometrical procedures.....	۳۶
۴. Molecular markers: RAPD marker.....	۳۸
<b>RESULTS AND DISCUSSION</b> .....	۴۵
۱. Field experiment (Genetic analysis of wheat characters)..	۴۵
a. Analysis of variance.....	۴۵
b. Mean performance.....	۴۷
c. Heterosis .....	۵۱
d. Combining ability .....	۵۷
۲. Molecular markers analysis (RAPD).....	۶۳
a. RAPD analysis for wheat parental genotypes.....	۶۳
۱. Genetic identification of the studied parents by RAPD markers.....	۶۷
۲. Genetic identification by unique markers for the seven parental genotypes.....	۷۶
۳. Genetic relationships between the studied parents as revealed by RAPD markers.....	۷۷
b. RAPD analysis for the wheat crosses.....	۸۰
The genetic identification of the ۲۱ wheat hybrids by RAPD marker .....	۱۰۳
c. The relation between RAPD marker and hybrid performance.....	۱۰۷
<b>SUMMARY</b> .....	۱۰۹



<b>REFERENCES .....</b>	<b>١١٦</b>
<b>APPENDIX.....</b>	<b>١٣٤</b>
<b>ARABIC SUMMARY .....</b>	

## LIST OF TABLES

No	Title	page
١.	Pedigree and origin of the seven wheat parental genotypes used in the present investigation.....	٢٠
٢.	Form analysis of variance for the seven parents and their ٢١ F <sub>١</sub> crosses as well as expected mean squares (EMS) according to Griffing (١٩٥٦) model I, method II.....	٢٣
٣.	List of random primers and their nucleotide sequences used in RAPD analysis.....	٢٧
٤.	Mean squares for morphological and yield components traits of ٢٨ wheat genotypes. ....	٣٢
٥.	Average of all studied traits for ٢٨ wheat genotypes grown under normal conditions.....	٣٤
٦.	Better parent percentage for plant height, heading date, grain yield/plant, number of spikes/plant, kernel weight/main spike, ١٠٠٠- kernel weight and number of kernels/spike of ٢٨ wheat genotypes grown under normal conditions.....	٣٩
٧.	Estimates of general and specific combining ability for all studied traits of ٢٨ wheat genotypes grown under normal conditions.....	٤٥
٨.	Number of amplified DNA fragments produced by each RAPD primer for the ٢٨ wheat genotypes.....	٥٢
٩.	Total number of amplicons, number of monomorphic and polymorphic amplicons and the percentage of polymorphism, as revealed by RAPD primers for the studied wheat parents.....	٥٣
١٠.	Data matrix illustrating the presence or absence of RAPD bands produced by primer (OPX-١١) in the studied seven	٥٤

wheat genotypes.....	
١١. Data matrix illustrating the presence or absence of RAPD bands produced by primer (OPT-٠٨) in the studied seven wheat genotypes .....	٥٦
١٢. Data matrix illustrating the presence or absence of RAPD bands produced by primer (OPC-١٩) in the studied seven wheat genotypes .....	٥٨
١٣. Data matrix illustrating the presence or absence of RAPD bands produced by primer (OPX-١٧) in the studied seven wheat genotypes .....	٥٨
١٤. Data matrix illustrating the presence or absence of RAPD bands produced by primer (OPD-١٣) in the studied seven wheat genotypes .....	٥٩
١٥. Data matrix illustrating the presence or absence of RAPD bands produced by primer (OPW-٠٤) in the studied seven wheat genotypes .....	٥٩
١٦. Data matrix illustrating the presence or absence of RAPD bands produced by primer (OPN-٠٦) in the studied seven wheat genotypes .....	٦١
١٧. Data matrix illustrating the presence or absence of RAPD bands produced by primer (OPA-٠٣) in the studied seven wheat genotypes .....	٦١
١٨. Data matrix illustrating the presence or absence of RAPD bands produced by primer (OPC-١٥) in the studied seven wheat genotypes .....	٦٢
١٩. Data matrix illustrating the presence or absence of RAPD bands produced by primer (OPN-٠٤) in the studied seven wheat genotypes .....	٦٢
٢٠. Positive and negative unique RAPD markers generated for five parental wheat genotypes.....	٦٤

۲۱. Genetic similarity matrices computed according to Dice Coefficient from RAPD between the seven parental wheat genotypes.....	۶۵
۲۲. Illustrating the presence or absence of RAPD bands in the seven types of RAPD marker.....	۶۸
۲۳. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (۱) and its parents (extracted from zero, one data).....	۶۹
۲۴. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (۲) and its parents (extracted from zero, one data).....	۷۰
۲۵. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (۳) and its parents (extracted from zero, one data).....	۷۱
۲۶. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (۴) and its parents (extracted from zero, one data).....	۷۲
۲۷. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (۵) and its parents (extracted from zero, one data).....	۷۳
۲۸. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (۶) and its parents (extracted from zero, one data).....	۷۵
۲۹. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (۷) and its parents (extracted from zero, one data).....	۷۶
۳۰. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (۸) and its parents (extracted from zero, one data).....	۷۷
۳۱. Number of detected bands in the three categories, included	۷۸

the seven types of RAPD markers of hybrid number (٩) and its parents (extracted from zero, one data).....	
٣٢. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (١٠) and its parents (extracted from zero, one data).....	٧٩
٣٣. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (١١) and its parents (extracted from zero, one data).....	٨٠
٣٤. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (١٢) and its parents (extracted from zero, one data).....	٨١
٣٥. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (١٣) and its parents (extracted from zero, one data).....	٨٢
٣٦. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (١٤) and its parents (extracted from zero, one data).....	٨٣
٣٧. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (١٥) and its parents (extracted from zero, one data).....	٨٤
٣٨. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (١٦) and its parents (extracted from zero, one data).....	٨٥
٣٩. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (١٧) and its parents (extracted from zero, one data).....	٨٦
٤٠. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (١٨) and its parents (extracted from zero, one data).....	٨٧
٤١. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (١٩) and its parents (extracted from zero, one data).....	٨٨

its parents (extracted from zero, one data).....	
٤٢. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (٢٠) and its parents (extracted from zero, one data).....	٨٩
٤٣. Number of detected bands in the three categories, included the seven types of RAPD markers of hybrid number (٢١) and its parents (extracted from zero, one data).....	٩٠
٤٤. Total number of bands and their percentages in the three categories for the studied ٢١ wheat hybrids.....	٩٢
٤٥. Pearson correlations between genetic distance (measured using Dice's coefficient) with heterosis (H) and specific combining ability (SCA) for grain yield per plant.....	٩٥

## LIST OF FIGURES

No	Title	Page
1.	Molecular weight of the DNA ladder (GeneRuler™) Fermentas.....	28
2.	RAPD profiles of the 28 wheat genotypes (parents and their hybrids) amplified with primers OPX-11, OPT-18 and OPC- 19 .....	55
3.	RAPD profiles of the 28 wheat genotypes (parents and their hybrids) amplified with primers OPX-12, OPD-13 and OPW- 14 .....	57
4.	RAPD profiles of the 28 wheat genotypes (parents and their hybrids) amplified with primers OPN-16, OPA-17, OPC-18 and OPN-19 .....	61
5.	Dendrogram for the seven parental wheat genotypes, constructed from RAPD analysis using unweighed pairgroup arithmetic average similarity matrix computed according to Dice coefficients.....	65