BIOMANAGMENT OF ABIOTIC POLLUTION IN NATURAL PROTECTORATES AND RIVER NILE IN EGYPT

By

NAHLA MOHAMED NAGUIB AHMED ABDELHAMID
B.Sc. Agric. Sci. (Biotechnology), Fac., Agric., Cairo Univ., Egypt, 2006

THESIS

Submitted in Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

In

Agricultural Sciences
(Agricultural Microbiology)

Department of Microbiology
Faculty of Agriculture
Cairo University
EGYPT

2015

SUPERVISION SHEET

BIOMANAGMENT OF ABIOTIC POLLUTION IN NATURAL PROTECTORATES AND RIVER NILE IN EGYPT

M.Sc. Thesis

In

Agric. Sci. (Agricultural Micorbiology)

By

NAHLA MOHAMED NAGUIB AHMED ABDELHAMID

B.Sc. Agric. Sci. (Biotechnology), Fac., Agric., Cairo Univ., Egypt, 2006

SUPERSIVION COMMITTEE

Dr. AZIZ MOHAMED AZIZ HIGAZY

Professor of Microbiology, Fac. Agric., Cairo University

Dr. OLFAT SAYED BARAKAT

Professor of Microbiology, Fac. Agric., Cairo University

ACKNOWLEDGEMENT

Ultimate thanks to ALLAH, who without his aid this work would not be done.

I wish to express my sincere thanks to ***Dr. Aziz Higazy*** *and* ***Dr. Olfat Barakat****, Professors of Agricultural Microbiology, Faculty of Agriculture, Cairo University, for supervision, continued assistance and guidance through the course of my study.*

My deepest gratitude to ***Dr. Reda Moghaieb****, Professor of Genetics, Faculty of Agriculture, Cairo University, for his assistance and help in genetic part in this study, and, valuable advice, encouragement, sincere efforts.*

I feel deeply grateful to my colleagues ***Mahmoud Fawzi, Mohamed Saed, Samah ELmaghraby, and Heba Adel****, Environmental Rescearchers, Nature Conservation Sector, Egyptian Environmental Affairs Agency, for their continuous assistance, help, valuable advice, sincere efforts and encouragement.*

I feel deeply thankful to my friend ***Etr Khashaba*** *Researcher, Agricultural Research Center for her help in genetic part in this study and continous encouragement.*

Special Thanks to ***Mohamed Ali*** *Manager of Wadi EL-Gemal Protectorate,* ***Samar Abdelazim*** *Manager of River Nile Islands Protectorate,* ***Haitham Ibrahim*** *colleague from Salugha and Ghazal Protectorate,* ***Ali Metrash*** *Manager of Qaroun Protectortae, and* ***Arafa Al-Sayed*** *Manager of Wadi EL-Rayan Protectorate; for their help in field work.*

Special deep appreciation is given to my mother, father and brother for all the support they lovely offered during my graduate studies.

Special thanks are also extended to all staff members of Department of Agricultural Microbiology, Faculty of Agriculture, Cairo University, for their continuous help, facilities and moral support.

Name of Candidate: Nahla Mohamed Naguib Ahmed **Degree:** M.Sc.
Title of Thesis: Biomanagment of Abiotic Pollution in Natural Protectorates and River Nile in Egypt
Supervisors: Dr. Aziz Mohamed Aziz Higazy
Dr. Olfat Sayed Barakat
Department: Agricltural Microbiology **Approval:** 28 / 05 /2015

ABSTRACT

Cyanobacteria constitute a versatile group of photosynthetic bacteria of immense medicinal, commercial and ecological importance with potential uses in biomanagement of industrial effluents especially with high concentration of heavy metals. The main objective of this study to find cyanobacterial species that may have role in biomanagment of abiotic pollution in the selected Egyptian protectorates which are not only differ in their aquatic habitat types but also geographically *e.g.* Ashtum El-Gamil, Saluga & Ghazal, Wadi El-Gemal, Abu galum, Qaroun, Wadi El-Rayan, and Dahab Island as one of river Nile islands protectorates. Those protectorates represent three different habitats *i.e.* marine, fresh water, brackish habitats. Physical parameters, chemical pollutants and microbiological pollutants were identified. Forty eight species of cyanobacteria were identifed of their diversity belonging to 4 orders, 11 families and 16 genera. The most common species found to be present in at least 4 protectorates were *Gomphosphaeria aponina*, *Merismopedia punctata*, *Merismopedia tenuissima*, *Microcystis aeruginosa*, and *Microcystis flos – aquae*. Species aligned to only one type of habitats were detected and 12 isolates were belonging to these category. *Aphanocapsa koordersi*, *Gloeocapsa decorticans*, *Oscillatoria claricentrosa*, *Oscillatoria foreoui*, *Oscillatoria okeni*, *Phormidium fragile*, *Myxosarcina burmensis* and *Phormidium angustissimum* were recorded in Wadi El-Rayan protectorates. Meanwhile, *Nostoc sp.*, *Oscillatoria sp.*, and *Spirulina sp.* recorded only in Ashtum El-Gamil; and *Anabaena sp.* in Wadi El-Gemal protectorate. RAPD molecular analysis was performed to show phylogenetic relationship among 6 dominant cyanobaterial isolates that reflect different ecological background from where each one was isolated. The high percentages of polymorphism reflect the effect of habitats on these isolates and explain why such isolates might be morphologically similar but genetically distinct. Through tracing distribution range of cyanobacteria for the 48 isolates and the last ten years in Egypt, there were 912 cyanobacterial records were allocated on ArcMap by GIS techniques to see the distribution range of those species throught the last 10 years and the diversity of cyanobacterial species in marine habitat is more than in either fresh or brackish. Finally, it was found that *Anabaena*, *Aphanocapsa*, *Chroococcus*, *Lyngbya*, *Merismopedia*, *Microcystis*, *Nostoc*, *Oscillatoria* and *Spirulina* might have a role in biomanagement of Cr, Cu, Fe, Zn, Mn, Hg, Cd, Ni and Pb. The priority biomanagement process to native species that were recorded in the area of pollution.

Key words: cyanobacteria, biodiversity, protectorates, aquatic ecosystems, Egypt, PCR-RAPD

CONTENTS

INTRODUCTION

Cyanobacteria constitute a versatile group of photosynthetic bacteria (Olson, 2006 and Jacquet *et al.*, 2013) that's why they are contributed significantly to global ecology and the oxygen cycle (Lane, 2010). They are known to be the oldest fossils on earth for more than 3.5 billion years ago. Stromatolites provide the ancient records on the earth that have been left by cyanobacteria (Whitton & Potts, 2002 and Lane, 2010).

several researches and studies all over the world have been established to discover diversity of cyanobacteria to fulfill the three main objectives of convention on biological diversity (CBD). These objectives are 1) conservation of biological diversity, 2) sustainable use of the component of biological diversity, 3) the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. By addressing the diversity of cyanobacteria, each country can know its own natural heritage even it was a bacteria. There were many databases established worldwide to gather all the information and data on cyanobacteria such as CyanoDB, WoRMS, algaebase, and others. They aim to record every species even it was cyanobacteria or not and give a complete information about it starting from taxonomy ended with distribution and genetic analysis if present in cooperation with Life watch, Catalogue of Life, Encyclopedia of Life, Global Biodiversity Information Facility. All these organizations, programs and initiatives have a certain objective which is providing all

information about every discovered species, which consequently helps to implement some of convention on biological diversity (CBD) goals.

To determine diversity at the genetic level, molecular characterizations for different cyanobacterial species were investigated. Complete sequenced genomes for 349 assembly projects were provided by the National Center for Biotechnlogy Information (National Center for Biotechnlogy Information, 2015).

In Egypt, scientists starting to addressing diversity of cyanobacterial species from decades such as Mohammed (2002), Hamed (2005), Hamed *et al.* (2007), Shehata *et al.* (2008), Hamed (2008), Abd El-Hady *et al.* (2012), and Naguib *et al.*, (2014). However, presence of new technologies like geographic information systems and remote sensing (Hamed *et al.*, 2007) make it become easier to predict distribution trends of cyanobacterial species and how much type of habitats and geographic range could affect presence of certain species. It also used in blooming prediction and quantity as Hamed *et al.* (2007) did.

Geographic Information System is a tool to predict locations and gives information about the current status of a certain species, *i.e.* is it no longer exist and in which habitats, is it increase in numbers and location. So it gives us a complete view on every species and helps scientists who are concerning with biodiversity and conservation to adopt programmes in order to maintain and conserve species and enhance sustainable use of each one.

The ecosystem defined as interaction between biotic components like plants, animals and microbes with abiotic components like air, water and mineral soil, in a specific and limited space. So, knowing diversity of cynobacteria will not only help in conserving using cyanobacteria itself but also give an idea about the other species accompanied with it and interact with it in the ecosystem.

Therefore, the present study was conducted to address the following main goal and thus three more targets have been located to achieve that goal:

1- Identify chemical and microbiological pollution.

2- Identifing diversity of cyanobacteria in some Egyptian protectorates distinguished by their different aquatic ecological features,
   a. Isolation, purification and identification of dominant cyanobacterial species,
   b. Phylogenetic relationship of cyanobacterial isolates within protected areas under study,
   c. Geographical distribution range of cyanobacteria in the last ten years in Egypt.

3- Biomanagment of abiotic pollution.