



جامعة الإسكندرية

كلية : الزراعة-سابقا باشا

قسم : الإنتاج النباتي

استجابة بعض أصناف عباد الشمس للإجهاد المائي والتسميد الحيوي

مقدمة من
مارى عريان ناشد حنين

رسالة علمية

مقدمة لاستيفاء متطلبات منح درجة دكتور الفلسفة في العلوم

الزراعية تخصص (المحاصيل)

قسم الإنتاج النباتي

جامعة الإسكندرية

٢٠١١



استجابة بعض أصناف عباد الشمس للإجهاد المائي والتسميد الحيوي

مقدمة من

مارى عريان ناشد حنين

للحصول على درجة

دكتور الفلسفة في العلوم الزراعية

تخصص (المحاصيل)

قسم الإنتاج النباتي

موافقون

لجنة الحكم والمناقشة

.....

الأستاذ الدكتور/ فتحي إبراهيم رضوان

أستاذ المحاصيل ورئيس قسم الإنتاج النباتي

كلية الزراعة (سابا باشا) جامعة الإسكندرية.

.....

الأستاذ الدكتور/ محمود عبد العزيز جمعة

أستاذ المحاصيل المتفرغ بقسم الإنتاج النباتي

كلية الزراعة (سابا باشا) جامعة الإسكندرية.

.....

الأستاذ الدكتور / محمد نجيب البنا

استاذ المحاصيل غير المتفرغ بقسم الإنتاج النباتي

كلية الزراعة (سابا باشا) – جامعة الإسكندرية

.....

الأستاذ الدكتور/ صبحي غريب رزق سرور

استاذ المحاصيل المتفرغ بقسم المحاصيل

كلية الزراعة -جامعة كفر الشيخ

.....

الأستاذ الدكتور/ مسعد عبد العاطي البطل

أستاذ المحاصيل المتفرغ بقسم بحوث فسيولوجيا المحاصيل-

معهد بحوث المحاصيل الحقلية- مركز البحوث الزراعية - الجيزة .



Alexandria University

Faculty of Agriculture

(Saba Basha)

Plant Production Dept .

RESPONSE OF SOME SUNFLOWER TO WATER STRESS AND BIOFERTILIZATION

By

MARY ERYAN NASHED HENEN

**A Thesis Submitted on Partial Fulfillment of the Requirements
Governing the Award of the Degree of**

**PHILOSOPHY DOCTOR OF AGRICULTURAL
SCIENCES**

(AGRONOMY)

PLANT PRODUCTION DEPARTMENT

ALEXANDRIA UNIVERSITY

٢٠١١



Alexandria University
Faculty of Agriculture
(Saba Basha)
Plant Production Dept .

RESPONSE OF SOME SUNFLOWER TO WATER STRESS AND BIOFERTILIZATION

Presented By
MARY ERYAN NASHED HENEN

For the Degree of
**PHILOSOPHY DOCTOR OF AGRICULTURAL SCIENCES
(AGRONOMY)
PLANT PRODUCTION DEPARTMENT**

Examiner's Committee:

Approved

Prof. Dr. Fathy Ibrahim Radwan

Professor of Agronomy,
and Head of Plant Production Department,
Faculty of Agriculture (Saba Basha),
Alexandria University.

.....

Prof.Dr.Mahmoud Abdel Aziz Gomaa

Emeritus Professor of Agronomy,
Plant Production Department, Faculty of
Agriculture (Saba Basha), Alexandria University

.....

Prof.Dr.Mohamed Naguib El- Banna

Non Emeritus Professor of Agronomy, Plant Production
Department, Faculty of Agriculture (Saba Basha),
Alexandria University

.....

Prof.Dr. Sobhy Gharib Rizk Sorour.

Emeritus Professor of Agronomy, Agronomy
Department, Faculty of Agriculture,
Kafrelsheikh University.

.....

Prof.Dr. Mosad Abd-Elaty El- Batal

Emeritus Professor of Agronomy, Department of
Crop Physiology Research, Field Crops Research
Institute, Agricultural Research Center, Giza

.....

CONTENTS

	Page
CONTENTS.....	I
LIST OF TABELS.....	iii
ACKNOWLEDGEMENT.....	vii
١-Chapter One:INTRODUCTION.....	٢
٢.Chapter Tow:REVIEW OF LITERATURE	٤
٢,١.Effect of irrigation.....	٤
٢,٢.Behaviour of sunflwre cultivars.....	٨
٢,٣.Effect of fertilization.....	٩
٢,٣,١.Effect of nitrogen.....	٩
٢,٣,٢.Effect of biofertilizer.....	١٠
٣.Chapter Three:MATREIALS AND METHODS.....	١٣
٣,١.Soil type.....	١٣
٣,٢.Treatments and exprimental layout.....	١٣
٣,٣.Studied characters.....	١٥
٣,٣,١.Growth characters and growth analysis.....	١٥
٣,٣,٢.Yield attributes.....	١٦
٣,٣,٣.Yield and yield components.....	١٦
٣,٣,٤. oil content(%).....	١٧
٣,٣,٥.Water relations.....	١٧
٣,٣,٦.Statistical analysis.....	١٧
٤.Chapter Four:RESULTS AND DISCUTION.....	١٩
٤,١.Growth characters and growth analysis.....	١٩
٤,١,١.Dry matter accumulation.....	١٩
٤,١,٢.Shoot dry weight.....	١٩
٤,١,٣.Dry mattre distribution.....	٢١

	Page
٤,١,٤.Leaf area/plant.....	٢٧
٤,١,٥.Crop growth rate(CGR).....	٣١
٤,١,٦.Relative growth rate(RGR).....	٣٣
٤,١,٧.Net assimilation rate(NAR).....	٣٣
٤,٢.Yield attributes.....	٤٢
٤,٢,١.Plant height.....	٤٢
٤,٢,٢.Stem diameter.....	٤٢
٤,٢,٣.Head diameter.....	٤٤
٤,٣.Yield and yield components.....	٤٤
٤,٣,١.Head dry weight.....	٤٤
٤,٣,٢,١٠٠٠-Seed weight.....	٤٥
٤,٣,٣.Stover weight/plant.....	٤٥
٤,٣,٤.Biological weight\plant.....	٤٧
٤,٣,٥.Seed weight/plant.....	٤٧
٤,٣,٦.Biological yield(kg/fed).....	٤٧
٤,٣,٧.Seed yield(kg/fed).....	٥٠
٤,٣,٨.Oil yield(kg/fed).....	٥٠
٤,٥.Seed oil content(%).....	٥١
٤,٦.Water relations.....	٥١
٤,٦,١.Transpiration rate(TR) and stomatal resistance(SR)	٥١
٤,٦,٢.Water consumptive use(WCU).....	٥٦
٤,٦,٤.Water use efficiency(WUE).....	٥٦
٥.Chapter Five:SUMMARY AND CONCLUSION.....	٦١
٦.Chapter Six:LITERATURE CITED.....	٦٨
٧.Chapter Seven:ARABIC SUMMARY.....	٨١

LIST OF TABLES

Table	Page
١ Some physical and chemical properties of the soil at experiment site in ٢٠٠٧ and ٢٠٠٨ seasons	١٤
٢ Field capacity ,wilting point , available soil moisture and bulk density at experimental site	١٤
٣ Effect of irrigation interval and biofertilizer on dry matter accumulation /plant(g) of two sunflower cultivars at three growth stages during ٢٠٠٧ and ٢٠٠٨ seasons.....	٢٠
٤ Effect of irrigation interval and biofertilizer on shoot dry weight/plant(g) of two sunflower cultivars at three growth stages during ٢٠٠٧ and ٢٠٠٨ seasons.....	٢٢
٥ Effect of irrigation interval and biofertilizer on head dry weight/plant(g) of two sunflower cultivars at three growth stages during ٢٠٠٧ and ٢٠٠٨ seasons.....	٢٣
٦ Effect of irrigation interval and biofertilizer on stem dry weight/plant(g) of two sunflower cultivars at three growth stages during ٢٠٠٧ and ٢٠٠٨ seasons.....	٢٤
٧ Effect of irrigation interval and biofertilizer on leaves dry weight/plant (g) of two sunflower cultivars at three growth stages during ٢٠٠٧ and ٢٠٠٨ seasons.....	٢٥
٨ Effect of irrigation interval and biofertilizer on root dry weight/plant(g) of two sunflower cultivars at three growth stages during ٢٠٠٧ and ٢٠٠٨ seasons.....	٢٦
٩ Interaction between irrigation interval and cultivar on head dry weight /plant of sunflower plants at ٤٦ DAS in ٢٠٠٧ and ٢٠٠٨ seasons.....	٢٨

Table	page
۱۰ Interaction between irrigation interval and cultivar for root dry weight /plant of sunflower plants at ۷۴ DAS in ۲۰۰۷ and at ۶۰ and ۷۴ DAS in ۲۰۰۸ seasons.....	۲۹
۱۱ Effect of irrigation interval and biofertilizer on leaves area/plant(cm ^۲) of two sunflower cultivars at three growth stages during ۲۰۰۷ and ۲۰۰۸ seasons.....	۳۰
۱۲ Effect of irrigation interval and biofertilizer on C.G.R.(g/week)of the two sunflower cultivars at three growth periods during ۲۰۰۷ and ۲۰۰۸ seasons	۳۲
۱۳ Interaction between irrigation interval and cultivar for crop growth rate (CGR)(g/week)of sunflower plants at different growth periods in ۲۰۰۷ and ۲۰۰۸ seasons.....	۳۴
۱۴ Interaction between cultivar and biofertilizer for crop growth rate(CGR) (g/week) of sunflower plants at ۶۰-۷۴ days in ۲۰۰۷ and ۲۰۰۸ seasons.....	۳۵
۱۵ Interaction between irrigation interval, cultivars and biofertilizer on crop growth rate (CGR)(g/week)of sunflower plants at ۶۰-۷۴ days in ۲۰۰۷ and ۲۰۰۸ Seasons.....	۳۶
۱۶ Effect of irrigation interval and biofertilizre on R.G.R.(g/g/week)of the two sunflower cultivars at two periods during ۲۰۰۷ and ۲۰۰۸ seasons..	۳۷
۱۷ Effect of irrigation interval and cultivar for relative growth rate R.G.R (g/g/week)of sunflower plants at ۴۶-۶۰ DAS in ۲۰۰۷ and ۲۰۰۸ seasons	۳۸
۱۸ Interaction between cultivar and biofertilizer for relative growth rate (RGR)(g/g/week) of sunflower plants at ۴۶-۶۰ DAS in ۲۰۰۷ season.....	۳۹
۱۹ Effect of irrigation interval and biofertilizer on NAR(g/dm ^۲ /week) of two sunflower cultivar in ۲۰۰۷ and ۲۰۰۸ seasons.....	۴۰

Table	Page
۲۰ Interaction between irrigation interval and cultivar for net assimilation rate (NAR)(g/dm ^۲ /week)of sunflower plants at different growth periods hn ۲۰۰۷ and ۲۰۰۸ seasons.....	۴۱
۲۱ Effect of irrigation interval and biofertilizer on plant height,stem diameter and head diameter (mg/dm ^۲ /week)of two sunflower cultivar in ۲۰۰۷ and ۲۰۰۸ seasons.....	۴۳
۲۲ Effect of irrigation interval and biofertilizer on head dry weight/ plant ,۱۰۰۰ seed weight/plant and stover weight/plant of two sunflower cultivars in ۲۰۰۷ and ۲۰۰۸ seasons.....	۴۶
۲۳ Effect of irrigation interval and biofertilizer on biological weight/ plant and seed weight/plant of two sunflower cultivars in ۲۰۰۷ and ۲۰۰۸ seasons.....	۴۸
۲۴ Effect of irrigation interval and biofertilizer on biological yield/fed, seed yield/fed and oil yield/fed of two sunflower cultivars in ۲۰۰۷ and ۲۰۰۸ seasons.....	۴۹
۲۵ Interaction between irrigation interval and cultivar of oil yield/fed of sunflower plants in ۲۰۰۷ and ۲۰۰۸ seasons.....	۵۲
۲۶ Effect of irrigation interval and biofertilizer on seed oil content(%) of two sunflower cultivar in ۲۰۰۷ and ۲۰۰۸ season.....	۵۳
۲۷ Effect of irrigation interval and biofertilizer on traspiration rate (TR.MgH ₂ O/CM/S) of two sunflower cultivars in ۲۰۰۷ and ۲۰۰۸ Seasons.....	۵۴
۲۸ Effect of irrigation interval on stomatal resistance (SR,S/Cm) of two Sunflower cultivars in ۲۰۰۷ and ۲۰۰۸ seasons.....	۵۵

Table	Page
۲۹ Effect of irrigation interval and biofertilizer on water consumptive use (wcu,m ^۳ /fed) of two sunflower cultivars in ۲۰۰۷ and ۲۰۰۸ Seasons.....	۵۷
۳۰ Effect of irrigation interval and biofertilizer on water use efficiency (WUE) of two sunflower cultivars in ۲۰۰۷ and ۲۰۰۸ seasons.....	۵۸

ACKNOWLEDGMENT

First and foremost, I feel always indebted to **GOD**, the most beneficent and merciful.

I wish sincerely to thank **Prof. Dr.Fathy Ibrahim Radwan** ,Professor of Agronomy, and Head of plant production Department, Faculty of Agriculture (Saba Basha), Alexandria University, for suggesting the problems, continues guidance, sincere supervision, and for every effort he did to complete this work.

I gratefully acknowledge **Prof. Dr.Mahmoud Abdel Aziz Gomaa**, Emeritus Professor of Agronomy, Plant Production Department, Faculty of Agriculture (Saba Basha), Alexandria University, for his helpful advice and keen supervision.

I would like to express my appreciation and deepest gratitude to **Prof. Dr. Mosad Abd-Elaty El- Batal** , Emeritus Professor of Agronomy, Crop Physiology Research ,Field Crops Research Institute, Agricultural Research Center, for valuable guidance, great help, time offered and connective criticism throughout this investigation.

Special thanks due to **all stuff** members of plant production Department, Faculty of Agriculture (Saba Basha), Alexandria University, and **all staff** members of Crop Physiology Research Department, Field Crops Research Institute, Agricultural Research Center, for their encouragement and great help.

Finally I would like to express my deepest appreciation from my heart to my **Father**, my **Mother**, my **Husband**, my **Son**, my **Daughter**, and **all Friends** for their support, encouragement, care patients during preparing Ph. D. Thesis.

Chapter one

INTRODUCTION

1. INTRODUCTION

Egypt is suffering from a great shortage in edible oils, so the Egyptian government is pressing hard to close the vast gap between production and consumption of edible oil.

Sunflower (*Helianthus annuus* L) is one of the main oil crops suggested to cover the increasing demand for edible oils in the country due to its adaptability to environmental condition and the high oil content in its seed up to 50%. Furthermore, sunflower oil has high content of unsaturated fatty acids and vitamin E. Moreover, its cake contains 20 – 30 % of protein which is mostly fed to livestock due to its high biological value.

Water stress is one of the sever conditions that affect crop productivity. Water being an integral part of plant, plays a vital role in the maintenance of plant life. The deficiency of water modifies soil-plant water relationship by lowering tissue water potential and impairing metabolic processes, (Akhtar *et al* 1993). Currently, water is a primary limiting factor in Egyptian agriculture and it is important to address our efforts to the fundamental issue of increasing crops production while reducing their water consumption especially in the reclaimed lands. This can be achieved through an effective use of modern irrigation techniques.

Sunflower cultivars markedly differ in their growth characteristics and potential yield. Several investigators under Egyptian conditions confirmed this fact.

Nitrogen plays an important role in plant growth and is considered as an indispensable element for several vital functions and needed for maximum yield in most field crops. It is well known that continue use and overuse of chemical fertilizers have caused soil pollution, agricultural and health consequences. Numerous efforts are being exercised everywhere to combat the adverse consequences of chemical farming by using alternative sources, which are environment friendly plant nutrients. In recent years, biofertilizers have emerged as a promising component of integrating nutrient supply system in agriculture. Our whole system depends on many important ways, on tremendous activities and there appear to be a tremendous potential for making use of microorganisms in increasing crop production (Bloemberg *et al* 2000). However, chemical fertilizers should applied alongside biofertilizers in suitable combination (Chowdhury and Mukherjee 2006). These methods of fertilizers aim to minimize chemical fertilizer application, reduce the production costs as well as environmental pollution which can occur by the excessive use of chemical fertilizers.

This investigation was carried out to study the effect of water intervals and biofertilizers in two sunflower cultivars on vegetative growth and productivity.

Chapter two
REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

The study of irrigation intervals, sunflower cultivars and biofertilization had received the attention of several workers. The role of each factor and its effect on different aspects of plant growth at vegetative and reproductive stages and seed yield, will be reviewed under the following headings:-

- 1- Effect of irrigation.
- 2- Behavior of sunflower cultivars.
- 3- Effect of fertilization.
 - 1- Effect of nitrogen.
 - 2- Effect of biofertilizer.

2-1 Effect of irrigation:

In natural environment, plants are subjected to stresses that adversely influence growth, metabolism and yield. Biotic and a biotic factor affect the growth of higher plants. Among these, drought is a major a biotic factor that limits agricultural crop production. (Reddy *et al* 2004).

Stress caused by drought does not occur abruptly, but develops slowly and increases in intensity by the time of duration in contrast to majority of other stress factors. (Larcher 2003).

Some investigators reported the effect of water stress on sunflower plants. **Deshmukh and Srivastava** (1982), **Rawson and Turner** (1983) and **Kandil** (1984) found that increasing irrigation interval reduced sunflower seed yield and seed oil percent.

Unger (1982) studied the influence of limited irrigation on sunflower growth, seed yield, oil percentage and quality. He found that, plants irrigated before flowering averaged 14 cm taller than those not irrigated between emergence and flowering. The highest seed yield (2.49 t/ha) was resulted with full irrigation. In addition to that, **Yegappan *et al*** (1982) applied three water stress treatments at early, mid and late vegetative stages in sunflower. They found that, final leaf area was reduced in all treatments. At full expansion of leaves, cell frequency had increased, cell number and cell area had decreased. These results help to explain the effects of stress on final leaf area, especially the reduced area of the lower leaves that are most sensitive to water stress. **Prunty** (1983) found that 1000 seed weight of sunflower was significantly increased by increasing irrigation rates. **Jones** (1984) stated that sunflower yield potential was enhanced when soil water content was increased. Furthermore, both quantity and distribution of water had a significant impact on achene and oil yield (**Fereres *et al*** 1986; **Andrich *et al*** 1996; **Krizmanic *et al*** 2003; **Reddy *et al*** 2003 and **Iqbal *et al*** 2005).