



شبكة المعلومات الجامعية  
التوثيق الإلكتروني والميكرو فيلم

# بسم الله الرحمن الرحيم



**MONA MAGHRABY**



شبكة المعلومات الجامعية  
التوثيق الإلكتروني والميكرو فيلم



# شبكة المعلومات الجامعية التوثيق الإلكتروني والميكرو فيلم



**MONA MAGHRABY**



شبكة المعلومات الجامعية  
التوثيق الإلكتروني والميكروفيلم

# جامعة عين شمس

## التوثيق الإلكتروني والميكروفيلم

### قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها  
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



### يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



**MONA MAGHRABY**

# **EFFECT OF COMPOST FERTILIZATION RATES ON GROWTH, YIELD AND SOME ACTIVE CONSTITUENTS OF TWO VARIETIES OF CALENDULA OFFICINALIS**

**Submitted By**

**Hesham Roshdey Abdelfatah Fatta**

B.Sc. of Agricultural Sciences (Desert Land Reclamation & Cultivation  
Technology), Faculty of Agriculture, Cairo University, 2007

A Thesis Submitted in Partial Fulfillment  
Of  
The Requirement for the Master Degree  
In  
Environmental Sciences

Department of Environmental Agricultural Sciences  
Institute of Environmental Studies and Research  
Ain Shams University

**2021**

APPROVAL SHEET  
**EFFECT OF COMPOST FERTILIZATION RATES  
ON GROWTH, YIELD AND SOME ACTIVE  
CONSTITUENTS OF TWO VARIETIES  
OF CALENDULA OFFICINALIS**

Submitted By

**Hesham Roshdey Abdelfatah Fatta**

B.Sc. of Agricultural Sciences (Desert Land Reclamation & Cultivation  
Technology), Faculty of Agriculture, Cairo University, 2007

A Thesis Submitted in Partial Fulfillment  
Of  
The Requirement for the Master Degree  
In  
Environmental Sciences  
Department of Environmental Agricultural Sciences

**This thesis was discussed and approved by:**

Name

Signature

**1-Prof. Dr. Reham Sabry Abdel-Raouf Mohamed**

Associate Researcher Prof. of Medicinal and Aromatic Plants  
National Research Centre

**2-Prof. Dr. Mohamed Zaky El-Shinawy**

Prof. of Vegetable Crops– Horticulture Department  
Faculty of Agriculture  
Ain Shams University

**3-Prof. Dr. Abd El-Aziz Mohamed Hosni**

Emeritus Prof. of Medicinal and Aromatic Plants – Horticulture Department  
Faculty of Agriculture  
Ain Shams University

**2021**

# **EFFECT OF COMPOST FERTILIZATION RATES ON GROWTH, YIELD AND SOME ACTIVE CONSTITUENTS OF TWO VARIETIES OF CALENDULA OFFICINALIS**

**Submitted By**

**Hesham Roshdey Abdelfatah Fatta**

B.Sc. of Agricultural Sciences (Desert Land Reclamation & Cultivation  
Technology), Faculty of Agriculture, Cairo University, 2007

**A Thesis Submitted in Partial Fulfillment**

**Of**

**The Requirement for the Master Degree**

**In**

**Environmental Sciences**

**Department of Environmental Agricultural Sciences**

**Under The Supervision of:**

**1-Prof. Dr. Abd El-Aziz Mohamed Hosni**

Emeritus Prof. of Medicinal and Aromatic Plants – Horticulture Department  
Faculty of Agriculture  
Ain Shams University

**2-Dr. Mohamed Hawedy Mahmoud Ramadan**

Lecturer of Medicinal and Aromatic Plants – Horticulture Department  
Faculty of Agriculture  
Ain Shams University

**3-Prof. Dr. Mahmoud Hesham Selim**

Researcher of Plant Chemistry  
National Organization for Drug Control & Research

**2021**



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

سبحانك لا علم لنا  
إلا ما علمتنا إنك أنت  
العليم العظيم

صدق الله العظيم

سورة البقرة الآية: ٣٢

# Acknowledgments

*First of all, deepest, greatest and most sincere thanks are always extended to "ALLAH" the most merciful and clement God.*

*Secondly, I would like to express my sincere gratitude to my supervisor Prof. Dr. Abdelaziz Mohamed Hosni for his constant support and encouragement during this master's degree program. This work would not have been possible without his guidance. It was an honor and a privilege to be a part of his research group.*

*Next, I want to thank Dr. Mohammed Hewidy for his support and help in completing this work. I would like to admit to the fact that his contribution was extremely helpful in teaching me basics of scientific research. He also assisted in collecting a lot of experimental data, field work and statistical analyses.*

*In addition, I would like to express my gratitude to Dr. Mahmoud Hesham Selim who provided me with the necessary support for assisting to complete my master's degree.*

*Here, I would never forget support of both Dr. Haney Hassan and Dr. Yehia Hesham. Moreover, I would like to offer my deepest thanks and gratitude to all my brothers Abd-elfatah, Yehia, Nahed, and Gamal.*

*Last but not least, my deepest gratitude is offered to my family, especially my wife, for all the care and moral support provided by her. This work could not have been concluded with high success without her patience and understanding.*



# Abstract

**Hesham Roshdey Abdelfatah Fatta. Effect of Compost Fertilization Rates on Growth, Yield and Some Active Constituents of Two Varieties of *Calendula officinalis*. Unpublished M.Sc. Thesis, Department of Environmental Agricultural Sciences, Institute of Environmental Studies and Research, Ain Shams University, 2020.**

This research study was carried out in pot experiments during the two successive seasons 2016-2017 and 2017-2018 at the Applied Research Center for Medicinal Plants, National Organization for Drug Control and Research (NODCAR) at Kafer El- Gable, Giza.

The main objective of this study was to investigate the effect of using compost, as an organic amendment, to replace some of the mineral fertilizers normally utilized, thus reducing the harmful effects of the excess of fertilizers as an environmental hazard and health problem.

Two types of fertilizers were applied, namely compost as organic, and NPK as mineral fertilizers creating six treatments: (1) 100% Organic (Org), (2) 100% Mineral (Min), (3) 75% Min + 25% Org, (4) 50% Min +50% Org, (5) 25% Min +75% Org and (6) without any fertilizers (control). They were used on two varieties of *Calendula officinalis* namely 'Costa Orange' and 'Costa Yellow'.

The results indicated that the highest values for the vegetative growth parameters, i.e. plant height (cm), flower diameter (cm), number of flower/ plant, above-ground fresh and dry weight/ plant(g), were obtained by the 100% Mineral fertilization treatment in the Yellow variety in both seasons respectively.

Meanwhile, the same trend of results followed suite for the active constituent, i.e. total carbohydrate content, total polyphenols and total flavonoids. Photosynthetic pigments like chlorophyll a, chlorophyll b, carotenoids content and oil yield, oil constituents responded in the same way when assessed in the Orange cultivar of *Calendula officinalis* in both seasons.

**Keywords:** Pot marigold, *Calendula officinalis*, Var. Costa Yellow and Orange, Compost, NPK Fertilization, Flowering, Flavonoids, Polyphenol, Oil constituents.

# LIST OF CONTENTS

Title	page
List of Contents	I
List of Tables	IV
List of Figures	VII
List of Plates	IX
List of Abbreviations	X
1. INTRODUCTION	1
2. REVIEW OF LITERATURE	5
2.1. Pot marigold ( <i>Calendula officinalis</i> L.)	6
2.1.1. Preface	6
2.1.2. <i>Calendula officinalis</i> as an ornamental plant	7
2.1.3. <i>Calendula officinalis</i> as a medicinal plant	7
2.2. Effect of Compost as an Organic Fertilizer	7
2.2.1. On vegetative and flowering parameters	7
2.2.2. On active constituents	11
2.3. Effect of Compound Mineral Fertilizers	12
2.3.1. On vegetative and flowering parameters	12
2.3.2. On active constituents	14
2.4. Effect of Blending Organic and Mineral Fertilizers	15
3. MATERIALS AND METHODS	17
3.1. Location and Duration	18
3.2. Plant Materials	18
3.3. Fertilization Components Utilized	19
3.4. Experimental Treatments	20

<b>Title</b>	<b>page</b>
<b>3.5. Result Data Recorded</b>	<b>21</b>
<b>3.6. Extraction of Essential Oil</b>	<b>22</b>
<b>3.7. Experimental Design and Statistical Analysis</b>	<b>22</b>
<b>4.RESULTS AND DISCUSSION</b>	<b>23</b>
<b>4.1. Effect of Fertilization on Vegetative Parameters of Two <i>Calendula officinalis</i> Cultivars</b>	<b>24</b>
<b>4.1.1. Plant height</b>	<b>24</b>
<b>4.1.2. Above-ground fresh weight</b>	<b>25</b>
<b>4.1.3. Above-ground dry weight</b>	<b>28</b>
<b>4.1.4. Number of flowers /plant</b>	<b>30</b>
<b>4.1.5. Flower diameter</b>	<b>34</b>
<b>4.1.6. Flower dry weight</b>	<b>35</b>
<b>4.2. Effect of Fertilization on Internal Chemical Contents of Two <i>Calendula officinalis</i> Cultivars</b>	<b>37</b>
<b>4.2.1. Nitrogen content (%)</b>	<b>37</b>
<b>4.2.2. Phosphorus content (%)</b>	<b>39</b>
<b>4.2.3. Potassium content (%)</b>	<b>41</b>
<b>4.2.4. Chlorophyll a content</b>	<b>43</b>
<b>4.2.5. Chlorophyll b content</b>	<b>45</b>
<b>4.2.6. Carotenoids content</b>	<b>47</b>
<b>4.2.7. Total carbohydrate content</b>	<b>49</b>
<b>4.3. Effect of Fertilization on Flower Active Constituents of Two <i>Calendula officinalis</i> Cultivars</b>	<b>51</b>
<b>4.3.1. Total polyphenols content</b>	<b>51</b>

<b>Title</b>	<b>page</b>
<b>4.3.2. Total flavonoids content</b>	<b>53</b>
<b>4.3.3. Oil yield</b>	<b>55</b>
<b>4.3.3. Oil constituents</b>	<b>57</b>
<b>5. SUMMARY AND CONCLUSIONS</b>	<b>68</b>
<b>5.1. Summary of Results</b>	<b>69</b>
<b>5.2. Conclusions</b>	<b>70</b>
<b>6. REFERENCES CITED</b>	<b>72</b>
<b>ARABIC SUMMARY</b>	<b>1-3</b>

---

## List of Tables

Table No.	Table Heading	Page
1.	Product specifications of peat moss	18
2.	Chemical composition of vermiculite utilized.	19
3.	Composition of (Folcare Fort) compound fertilizer	19
4.	Chemical analysis of utilized compost	20
5.	Effect of fertilization treatments on plant height (cm) of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	25
6.	Effect of fertilization treatments on above-ground fresh weight /plant (g) of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	27
7.	Effect of fertilization treatments on above-ground dry weight /plant (g) of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	29
8.	Effect of fertilization treatments on number of flowers/plant of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	31
9.	Effect of fertilization treatments on flower diameter (cm) of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	35
10.	Effect of fertilization treatments on flower dry weight (g/plant) of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	37

<b>Table No.</b>	<b>Table Heading</b>	<b>Page</b>
11.	Effect of fertilization treatments on leaf chlorophyll a content of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	45
12.	Effect of fertilization treatments on leaf chlorophyll b content of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	47
13.	Effect of fertilization treatments on carotenoid content of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	49
14.	Effect of fertilization treatments on total carbohydrates content of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	51
15.	Effect of fertilization treatments on flower polyphenol contents (mg/g dry weight) of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	53
16.	Effect of fertilization treatments on flower flavonoid contents (mg/g) dry weight of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	55
17.	Effect of fertilization treatments on volatile oil% (v/w) of two <i>Calendula officinalis</i> cultivars in two seasons 2016-2017 and 2017-2018.	57
18.	Effect of type of cultivar on flower volatile oil profile of <i>Calendula officinalis</i> in two seasons 2016-2017 and 2017-2018.	59



<b>Table No.</b>	<b>Table Heading</b>	<b>Page</b>
19.	Effect of various fertilization treatments on flower volatile oil profile of <i>Calendula officinalis</i> in the first season2016-2017.	60
20.	Effect of various fertilization treatment on flower volatile oil profile of <i>Calendula officinalis</i> flowers in the second season(2017-20180	61
21.	Effect of the interaction between type of cultivar and fertilization treatment on flowers volatile oil profile (%) in two cultivar of <i>Calendula officinalis</i> in the first season(2016-2017)	62
22.	Effect of the interaction between type of cultivar and fertilization treatment on flowers volatile oil profile (%) in two cultivar of <i>Calendula officinalis</i> in the second season(2016-2017).	63