



PHYTOREMEDIATION OF THE AIR POLLUTION USING SOME PLANTS IN THREE DIFFERENT LOCATIONS OF ALEXANDRIA CITY

BY

Naira Ali Ahmed Ibrahim

B.Sc. Agric. science, (Floriculture- Ornamental plant- Horticulture)

2008 - Faculty of Agriculture - Alexandria University

**M.Sc. Degree of Agric. Science- Plant production (Ornamental tissue
culture) 2012- Faculty of agriculture-Alexandria University**

THESIS

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

DOCTOR OF PHILOSOPHY

In

**Environmental Science
(Agricultural Science)**

**Department of Environment Sustainable Development and
Management of Its Projects Environmental Studies and Research
Institute (ESRI)
University of Sadat City
EGYPT**

2019

Name of Candidate: Naira Ali Ahmed Ibrahim

Degree: Ph.D.

Title of thesis: PHYTOREMEDIATION OF THE AIR POLLUTION USING SOME PLANTS IN THREE DIFFERENT LOCATIONS OF ALEXANDRIA CITY.

Supervisors: Dr. Inas Zakaria Abdel-Salam.....

Dr. Ashraf Abdel-Hamid Hassan Zahran.....

Dr. Nader Ahmed Mohamed El-Shanhorey.....

Department: Environment Sustainable Development and Management of its Projects.

Branch: Agriculture Science

Approval: //

ABSTRACT

The present study was carried out in three zones in Alexandria governorate [El-Ebrahimeya zone (traffic zone), El-Max zone (industrial zone) and Antoniadis Park (control zone)] during spring and autumn of two the successive seasons 2015 and 2016 to evaluate the effects of phytoremediation using two different species of shrubs as *Nerium oleander* and *Pittosporum tobira* plants on reducing the air pollution content with heavy metal (lead, cadmium and zinc) in the three zones . Homogeneous seedlings of *Nerium oleander* and *Pittosporum tobira* were planted individually in plastic pots (30 cm diameter) filled with a mixture of sand and clay. Ninety plants were planted in three zones in Alexandria governorate (thirty plants each zone).

First, we study the effect on the vegetative growth characteristics for both kind of shrubs (*Nerium oleander* and *Pittosporum tobira*) which were (Plant height, No. of leaves, leaf area, leaves dry weight, stem dry weight, stem diameter, root length, root dry weight) and the chemical analysis for the studied kind of shrubs which were (N, P, K, concentration of chlorophyll content Index, total sugar content in leaves and the three HMs (Pb, Cd, and Zn)).

Second, determination of heavy metals especially (Pb, Cd, and Zn) that were more spread in Alexandria according to the previous study in soil samples and air samples that were collected from the three regions under study (Antoniadis park, El-Max, and El- Ebrahimeya). We determined the heavy metals by using atomic absorption spectrophotometer for plants samples and soil samples by using Inductively Coupled Plasma Spectrometry. The layout of the experimental design was a split-split plot design with three replicates.

The results emphasized that the data showed the effect of different locations on vegetative growth on *Nerium oleander* and *Pittosporum tobira* plants. In both seasons, *Nerium oleander* plants planted in Antoniadis Park had the highest leaves, stem, and roots parameters in the first and second seasons, respectively. While *Pittosporum tobira* plants planted in El- Max had the lowest vegetative growth rate in both seasons. The growth rate was also significantly affected by different periods during both seasons. Accordingly, it can be seen from the data were significantly increased gradually in the autumn, While, the lowest growth rate in the spring.

The results of chemical analysis for plant parts showed that the effect of different locations on lead, cadmium and zinc content in plant parts. In both seasons, *Pittosporum tobira* plants that planted in El-Max had the highest heavy metals content, while, *Nerium oleander* plants that planted in Antoniadis Park had the lowest lead, cadmium, and zinc content in the first and second seasons, respectively. Chemical analysis of heavy metals content in plant parts was also significantly affected by different periods during both seasons. Accordingly, it can be seen from the data that heavy metals were significantly increased gradually in the spring, while, the lowest heavy metals content (lead, cadmium, and zinc) in plant parts was the autumn in the first and second seasons, respectively.

The results of chemical analysis for soils indicated that the effect of different locations on lead, cadmium and zinc content in soils. In both seasons, the highest content of heavy metals was found in El-Max region during autumn from *Nerium oleander*, while the lowest content of heavy metals in soils was obtained in Antoniadis park during spring from *Pittosporum tobira* in the two successive seasons 2015 and 2016, respectively.

The results of chemical analysis for the leachates of parts of plants showed that the effect of different location on lead, cadmium, and zinc in the leachates. In both seasons, the highest content of heavy metals in the leachates of the parts of the plants was found in El-Max region during spring, while the lowest content of heavy metals was found in Antoniadis park during autumn in both season 2015 and 2016, respectively.

Keywords: *Nerium oleander*, *Pittosporum tobira*, heavy metals (Pb, Cd, and Zn), Alexandria governorate, air and soil pollution.

CONTENTS

| | Page |
|--|------------|
| ACKNOWLEDGEMNT | |
| INTRODUCTION..... | 1 |
| REVIEW OF LITERATUES..... | 5 |
| 1. Soil pollution with HMs (lead, cadmium and zinc). | 5 |
| 2. Air pollution with HMs (lead, cadmium and zinc) and TSP..... | 11 |
| 3. Phytoremediation by using some Shrubs..... | 17 |
| a. <i>Nerium oleander</i>..... | 17 |
| b. <i>Pittosporum tobira</i>..... | 22 |
| MATERIALS AND METHODS..... | 25 |
| RESULTS AND DISSICUSSION..... | 31 |
| 4. The vegetative growth characteristic of <i>Nerium oleander</i> and <i>Pittosporum tobira</i>..... | 31 |
| a. Plant height (cm) | 31 |
| b. Number of leaves (per plant) | 35 |
| c. Leaves dry weight (g) | 38 |
| d. Leaf area (cm²) | 41 |
| e. Stem diameter (cm) | 45 |
| f. Stem dry weight (g) | 48 |
| g. Root length (cm) | 51 |
| h. Root dry weight (g) | 53 |
| 5. The chemical constituent characteristic of <i>Nerium oleander</i> and <i>Pittosporum tobira</i>..... | 56 |
| a. Chlorophyll concentration index (SPAD) of leaves | 56 |
| b. Total sugar content of leaves (D.W.) | 60 |
| c. Nitrogen content of leaves (D.W) | 63 |
| d. Phosphorus content of leaves (D.W) | 67 |
| e. Potassium content of leaves (D.W) | 71 |
| f. Lead content in leaves (µg/g) | 75 |
| g. Cadmium content in leaves (µg/g) | 78 |
| h. Zinc content in leaves (µg/g) | 81 |
| i. Lead content in stems (µg/g) | 84 |
| j. Cadmium content in stems (µg/g) | 87 |
| k. Zinc content in stems (µg/g) | 90 |
| l. Lead content in roots (µg/g) | 93 |
| m. Cadmium content in roots (µg/g) | 96 |
| n. Zinc content in roots (µg/g) | 99 |
| o. Heavy metals (lead, cadmium and zinc) content in soil | 103 |

| | | | |
|----|-----|---|-----|
| | i | Lead content in soils (mg/kg) | 103 |
| | ii | Cadmium content in soils (mg/kg) | 106 |
| | iii | Zinc content in soils (mg/kg) | 109 |
| | P. | Heavy metals (lead, cadmium and zinc) content (mg/kg) in the filter paper | 112 |
| 6. | | Correlation relationships of Total Suspended particulate (TSP) and Particulate Matter Less Than 10 Micrometer (PM ₁₀) | 115 |
| 7. | | Concentration of available (lead, cadmium and zinc) in leachate of parts of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> | 117 |
| | | Soluble lead concentration in leachates of leaves (mg/l) | 117 |
| | a. | Soluble lead concentration in leachates of stems (mg/l) | 119 |
| | b. | Soluble lead concentration in leachates of roots (mg/l) | 121 |
| | c. | Soluble cadmium concentration in leachates of leaves (mg/l) | 124 |
| | d. | Soluble cadmium concentration in leachates in leachates of stems (mg/l) | 126 |
| | e. | Soluble cadmium concentration in leachates of roots (mg/l) | 128 |
| | f. | Soluble zinc concentration in leachates of leaves (mg/l) | 130 |
| | g. | Soluble zinc concentration in leachates of stems (mg/l) | 132 |
| | h. | Soluble zinc concentration in leachates of roots (mg/l) | 134 |
| | i. | Air Pollution Tolerance Index..... | 136 |
| 8. | | SUMMARY | 137 |
| | | CONCLUSION | 143 |
| | | REFERENCES | 144 |
| | | ARABIC SUMMARY | 1 |

LIST OF TABLES

| No. | | Page |
|-----|--|------|
| 1. | Some physical and chemical characteristics of studied soil | 26 |
| 2. | Weather data of Egypt- Alexandria- Monthly- 2015-2016..... | 27 |
| 3. | Means of plant height (cm) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 33 |
| 4. | Means of number of leaves (per plant) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 36 |
| 5. | Means of leaves dry weight (g) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 39 |
| 6. | Means of leaves area (cm ²) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 43 |
| 7. | Means of stem diameter (cm) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 47 |
| 8. | Means of stems dry weight (g) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 49 |
| 9. | Means of root length (cm) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 52 |
| 10. | Means of roots dry weight (g) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 54 |
| 11. | Means of chlorophyll concentration index (SPAD) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 58 |
| 12. | Means of total sugar content in leaves (D.W.) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016... | 61 |
| 13. | Means of nitrogen content (D.W.) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 65 |
| 14. | Means of phosphorus content (D.W.) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 69 |
| 15. | Means of potassium content (D.W.) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 73 |
| 16. | Means of lead content in leaves (µg/g) of <i>Nerium oleander</i> and | 76 |

| | | |
|-----|---|-----|
| | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | |
| | Means of cadmium content in leaves ($\mu\text{g/g}$) of <i>Nerium oleander</i> and | |
| 17. | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 79 |
| | Means of zinc content in leaves ($\mu\text{g/g}$) of <i>Nerium oleander</i> and | |
| 18. | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 82 |
| | Means of lead content in stems ($\mu\text{g/g}$) of <i>Nerium oleander</i> and | |
| 19. | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 85 |
| | Means of cadmium content in stems ($\mu\text{g/g}$) of <i>Nerium oleander</i> and | |
| 20. | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 88 |
| | Means of zinc content in stems ($\mu\text{g/g}$) of <i>Nerium oleander</i> and | |
| 21. | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 91 |
| | Means of lead content in roots ($\mu\text{g/g}$) of <i>Nerium oleander</i> and | |
| 22. | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 94 |
| | Means of cadmium content in roots ($\mu\text{g/g}$) of <i>Nerium oleander</i> and | |
| 23. | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 97 |
| | Means of zinc content in roots ($\mu\text{g/g}$) of <i>Nerium oleander</i> and | |
| 24. | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 101 |
| | Means of lead content in soil (mg/kg) of <i>Nerium oleander</i> and | |
| 25. | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 104 |
| | Means of cadmium content in soil (mg/kg) of <i>Nerium oleander</i> and | |
| 26. | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 107 |
| | Means of zinc content in soil (mg/kg) of <i>Nerium oleander</i> and | |
| 27. | <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 110 |
| 28. | Means of Heavy metal (lead, cadmium and zinc) content in filter paper (mg/kg) | 112 |
| | Correlation coefficient between the three pollutants (Pb, Zn and Cd), TSP (Total suspended particles) and PM_{10} (Particulate Matter Less Than 10 Micrometer) in <i>Nerium oleander</i> plant..... | |
| 29. | Correlation coefficient between the three pollutants (Pb, Zn and Cd), TSP (Total suspended particles) and PM_{10} (Particulate Matter Less Than 10 Micrometer) in <i>Pittosporum tobira</i> plant..... | 115 |
| 30. | Means of soluble lead concentration in the leachate of leaves (mg/l) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by | 118 |

| | | |
|-----|--|-----|
| | locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | |
| 32. | Means of soluble lead concentration in the leachate of stems (mg/l) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 120 |
| 33. | Means of soluble lead concentration in the leachate of roots (mg/l) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 123 |
| 34. | Means of soluble cadmium concentration in the leachate of leaves (mg/l) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 125 |
| 35. | Means of soluble cadmium concentration in the leachate of stems (mg/l) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016..... | 127 |
| 36. | Means of soluble cadmium concentration in the leachate of roots (mg/l) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 129 |
| 37. | Means of soluble zinc concentration in the leachate of leaves (mg/l) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 131 |
| 38. | Means of soluble zinc concentration in the leachate of stems (mg/l) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 133 |
| 39. | Means of soluble zinc concentration in the leachate of roots (mg/l) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 135 |
| 40. | APTI values for <i>Nerium oleander</i> and <i>Pittosporum tobira</i> (g/m ²) | 136 |

LIST OF FIGURES

| No. | | Page |
|-----|--|------|
| 1. | Means of plant height (cm) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 34 |
| 2. | Means of number of leaves (per plant) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 37 |
| 3. | Means of leaves dry weight (g) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 40 |
| 4. | Means of leaves area (cm ²) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 44 |
| 5. | Means of stems dry weight (g) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 50 |
| 6. | Means of roots dry weight (g) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 55 |
| 7. | Means of chlorophyll concentration index (SPAD) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 59 |
| 8. | Means of total sugar content in leaves (D.W.) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016... | 62 |
| 9. | Means of nitrogen content (D.W.) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 66 |
| 10. | Means of phosphorus content (D.W.) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 69 |
| 11. | Means of potassium content (D.W.) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 74 |
| 12. | Means of lead content in leaves (µg/g) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 77 |
| 13. | Means of cadmium content in leaves (µg/g) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 80 |
| 14. | Means of zinc content in leaves (µg/g) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 83 |

| | | |
|-----|--|-----|
| 15. | Means of lead content in stems ($\mu\text{g/g}$) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 86 |
| 16. | Means of cadmium content in stems ($\mu\text{g/g}$) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 89 |
| 17. | Means of zinc content in stems ($\mu\text{g/g}$) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 92 |
| 18. | Means of lead content in roots ($\mu\text{g/g}$) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 95 |
| 19. | Means of cadmium content in roots ($\mu\text{g/g}$) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 98 |
| 20. | Means of zinc content in roots ($\mu\text{g/g}$) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 102 |
| 21. | Means of lead content in soil (mg/kg) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 105 |
| 22. | Means of cadmium content in soil (mg/kg) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 108 |
| 23. | Means of zinc content in soil (mg/kg) of <i>Nerium oleander</i> and <i>Pittosporum tobira</i> plants as influenced by locations, plants, periods and their interaction in the two seasons of 2015 and 2016 | 111 |
| 24. | Means of Heavy metal (lead, cadmium and zinc) content in filter paper (mg/kg) | 113 |

الدرجة : الدكتوراه

اسم الطالبه : نيره علي أحمد ابراهيم

عنوان الرسالة: استخدام بعض التباتات في معالجه تلوث الهواء في ثلاث مناطق مختلفه في مدينه الاسكندريه.

المشرفون : دكتور/ ايناس زكريا عبد السلام.....

دكتور / اشرف عبد الحميد زهران.....

دكتور/ نادر احمد محمد الشتهوري.....

قسم: التنمية المتواصله واداره مشروعاتها

التخصص: العلوم البينيه (العلوم الزراعيه)

تاريخ منح الدرجة: //

المستخلص العربي

اجريت هذه الدراسه في ثلاثه مناطق في محافظه الاسكندريه (منطقه الإبراهيمية (منطقة الإقامة والمرور) ، ومنطقة المكس (المنطقه الصناعيه) و حديقته أنطونيداس (منطقة الكنترول)) خلال فصلي الربيع والخريف من موسمين متتاليين 2015 و 2016 لتقييم آثار المعالجة النباتية باستخدام نوعين مختلفين من الشجيرات مثل نباتات التفله و البتسبورم على تقليل محتوى تلوث الهواء بالمعادن الثقيل. (الرصاص والكاديوم والزنك) في المواقع الثلاثه. تم زرع شتلات متجانسه من التفله و البتسبورم بشكل فردي في أواني بلاستيكي (قطرها 30 سم) مملوءة بمزيج من الرمل والطين) بحيث زرعت تسعين نبات في ثلاثة مواقع في محافظه الإسكندرية (ثلاثون نبات لكل منطقة).

أولاً دراسه التأثير على خصائص النمو الخضري لكلا النوعين من الشجيرات التفله و البتسبورم والتي كانت تشمل الاتي (ارتفاع النبات، عدد الاوراق، مساحه الاوراق،الوزن الجاف للاوراق،الوزن الجاف للجذور، طول الساق، قطر الساق، طول الجذر،الوزن الجاف للجذور) بالإضافة الى دراسه التحليلات الكيمياءيه والتي تشمل الاتي (مؤشر تركيز محتوى الكلوروفيل ، إجمالي محتوى السكر والمعادن الثقيله موضع الدراسه(الزنك و الكاديوم و الرصاص)، بالإضافة الى العناصر الكبرى والتي تتضمن(البوتاسيوم، النيتروجين، الفوسفور)).

ثانيا تحديد المعادن الثقيله خاصه (الرصاص، الكاديوم، الزنك) التي كانت اكثر انتشارا في مدينه الاسكندريه وفقا للدراسه السابقه لعينات التربه وعينات الهواء التي تم جمعها من الثلاث مناطق قيد الدراسه (منطقه المكس، منطقته الإبراهيميه و حديقته انطونيداس). وحددنا المعادن الثقيلة باستخدام مقياس الطيف الامتصاص الذري لعينات النباتات وعينات التربه باستخدام مقياس الطيف البلازمي.

أكدت النتائج أن البيانات أظهرت تأثير المواقع المختلفه على النمو الخضري على نباتات التفله و البتسبورم. في كلا الموسمين الاول والثاني كانت نباتات التفله التي تم زراعتها في منطقته انطونيداس تحتوي على اعلى قيمه للاوراق واليسقان والجذور. بينما اقل قيمه كانت من نباتات البتسبورم التي تم زراعتها في منطقته المكس. كما تأثر معدل النمو بشكل كبير بفترات مختلفه خلال كلا الموسمين وفقا لذلك ، يمكن أن نرى من البيانات زادت بشكل كبير تدريجيا في فصل الخريف ، في حين أن أدنى معدل نمو في الربيع.

أظهرت نتائج التحليل الكيمياءي لأجزاء النبات أن تأثير المواقع المختلفه على محتوى الرصاص والكاديوم والزنك في أجزاء النبات الموسمين ، كانت نباتات البتسبورم المزروعة في المكس تحتوي على أعلى نسبة من المعادن الثقيلة ، في حين كانت نباتات التفله التي كما زرعت في حديقته انطونيداس تحتوي على أقل محتوى من الرصاص والكاديوم والزنك في الموسمين الأول والثاني على التوالي تأثر التحليل الكيمياءي لمحتوى المعادن الثقيلة في أجزاء النبات بشكل كبير بفترات مختلفه خلال كلا الموسمين أن نلاحظ من البيانات أن المعادن الثقيلة قد ازدادت بشكل تدريجي في الربيع ، بينما كان أدنى محتوى للمعادن الثقيلة (الرصاص والكاديوم والزنك) في وفقا لذلك ، يمكن أجزاء النبات هو الخريف في الموسمين الأول والثاني على التوالي.

أشارت نتائج التحليل الكيمياءي للتربة إلى أن تأثير المواقع المختلفه على محتوى الرصاص والكاديوم والزنك في التربه حيث تم العثور على نسبة من المعادن الثقيلة في منطقته المكس خلال فصل الخريف من نبات التفله في حين تم الحصول على ادنى محتوى من المعادن الثقيلة في التربه في حديقته انطونيداس خلال فصل الربيع من البتسبورم في الموسمين المتتاليين 2015 و 2016 ، على التوالي.

أظهرت نتائج التحليل الكيمياءي للمادة المرتشحة لأجزاء من النباتات أن تأثير المواقع المختلف على محتوى الرصاص والكاديوم والزنك في مياه غسيل الاجزاء النباتيه في منطقته المكس خلال فصل الربيع بينما تم العثور على أقل محتوى من المعادن الثقيلة في حديقته أنتونيداس خلال فصل الخريف في كل من موسم 2015 و 2016 ، على التوالي.

الكلمات الداله: نبات التفله، نبات البتسبورم، تلوث الهواء، تلوث التربه، الرصاص، الزنك، الكاديوم، محافظه الاسكندريه



استخدام بعض النباتات في معالجة تلوث الهواء في ثلاث مناطق مختلفة في الاسكندرية

رسالة مقدمة من:

نيرة على أحمد إبراهيم

بكالوريوس في العلوم الزراعية (زهور ونباتات الزينة - بساتين) 2008- كلية الزراعة- جامعة الاسكندرية
ماجستير في العلوم الزراعية (إنتاج نباتي) 2012- كلية الزراعة – جامعة الإسكندرية

للحصول على درجة:
دكتوراه الفلسفة في العلوم البيئية
(علوم زراعية)

قسم التنمية المتواصلة للبيئة وإدارة مشروعاتها
معهد الدراسات والبحوث البيئية
جامعة مدينة السادات

2019