

# CONTENTS

	Page
1. INTRODUCTION .....	1
2. REVIEW OF LITERATURE .....	3
2.1. Sources of heavy metal contaminants in soils .....	3
2.2. Status of some heavy metals in soil .....	5
*2.2.1. Lead (Pb). .....	5
2.2.2. Nickel (Ni). .....	9
2.2.3. Chromium (Cr).....	11
2.3. Factors affecting status of heavy metals in soil .....	14
2.3.1. Soil reaction (pH).....	14
2.3.1.1. Lead (Pb). .....	14
2.3.1.2. Nickel (Ni). .....	14
2.3.1.3. Chromium (Cr).....	16
2.3.2. CaCO <sub>3</sub> content .....	17
2.3.2.1. Lead (Pb). .....	17
2.3.2.2. Nickel (Ni). .....	18
2.3.2.3. Chromium (Cr).....	18
2.3.3. Organic matter.....	19
2.3.3.1. Lead (Pb). .....	20
2.3.3.2. Nickel (Ni). .....	20
2.3.3.3. Chromium (Cr).....	21
2.2.4. Soil texture.....	22
2.2.4.1. Lead (Pb). .....	22
2.2.4.2. Nickel (Ni). .....	22
2.2.4.3. Chromium (Cr).....	23
2.4. Heavy metal contents in plant.....	23
2.4.1. Lead (Pb). .....	23

2.4.2. Nickel (Ni).....	26
2.4.3. Chromium (Cr).....	28
2.5. Remediation of soils contaminated with heavy metals	31
2.5.1. Chemical remediation.....	31
2.5.2. Phytoremediation .....	32
3. MATERIALS AND METHODS .....	35
3.1. Locations of the studied soils .....	35
3.2. Soil sampling.....	35
3.3. Experimental work .....	39
3.3.1. Incubation experiment .....	39
3.3.2. Greenhouse experiment.....	40
3.4. Laboratory analyses.....	41
3.4.1. Soil analyses .....	41
3.4.2. Plant analysis .....	42
4. RESULTS AND DISCUSSION.....	49
4.1. Status of some heavy metals in some soils of Qalubia Governorate.....	49
4.1.1. Lead (Pb) .....	49
4.1.2. Nickel (Ni).....	54
4.1.3. Chromium (Cr).....	59
4.2. Chemical remediation of some soils polluted with Pb, Ni and Cr.....	64
4.2.1. Effect of limestone (CaCO <sub>3</sub> ).....	64
4.2.1.1. Effect of limestone on AB-DTPA extractable Pb.....	65
4.2.1.2. Effect of limestone on AB-DTPA extractable Ni.....	68
4.2.1.3. Effect of limestone on AB-DTPA extractable Cr.....	68

4.2.2. Effect of calcium oxide (CaO).....	74
4.2.2.1. Effect of CaO on AB-DTPA extractable Pb.....	74
4.2.2.2. Effect of CaO on AB-DTPA extractable Ni.....	77
4.2.2.3. Effect of CaO on AB-DTPA extractable Cr.....	80
4.2.3. Effect of organic compounds.....	83
4.2.3.1. Effect of citric acid.....	83
4.2.3.1.1. Effect of citric acid on AB-DTPA extractable Pb .....	83
4.2.3.1.2. Effect of citric acid on AB-DTPA extractable Ni.....	86
4.2.3.1.3. Effect of citric acid on AB-DTPA extractable Cr.....	89
4.2.3.2. Effect of humic acid .....	92
4.2.3.2.1. Effect of humic acid on AB-DTPA extractable Pb .....	92
4.2.3.2.2. Effect of humic acid on AB-DTPA extractable Ni.....	95
4.2.3.2.3. Effect of humic acid on AB-DTPA extractable Cr.....	98
4.3. Phytoremediation by plants grown on some soils polluted with Pb, Ni and Cr. ....	102
4.3.1. Effect of <i>Nerium Oleander</i> .....	102
4.3.1.1. Dry matter yield, concentration and uptake of heavy metals.....	102
4.3.1.2. Effect of <i>Nerium Oleander</i> on heavy status in the studied soils.....	127
4.3.2. Effect of <i>Thevita Nerifolia</i> .....	132
4.3.2.1. Dry matter yield, concentration and uptake of heavy metals.....	132

4.3.2.2. Effect of <i>Thevita Nerifolia</i> on heavy status in the soils .....	157
5. SUMMARY .....	164
6. REFERENCES .....	168
7. APPENDIX .....	185
ARABIC SUMMARY .....	