

## CONTENTS

	Page
<b>ACKNOWLEDGEMENT</b>	
<b>DEDICATION</b>	
<b>CONTENTS</b>	v
<b>LIST OF TABELS</b>	viii
<b>LIST OF FIGURES</b>	xii
<b>INTRODUCTION</b>	1
<b>I : REVIEW OF LITRATURE</b>	3
<b>1- Iron nutrition in plants</b>	3
Mechanisms of iron uptake ✓	4
Higher plant Fe- efficiency reaction mechanisms	6
The Grass System	7
The Dicotyledon and non-grass Monocot. system	7
Correction of iron chlorosis	8
Foilar application	8
Soil application	9
Synthetic Fe chelates	10
Inorganic Fe compounds	12
<b>2- The role of soil CaCO<sub>3</sub> and soil iron in iron nutrition</b>	18
CaCO <sub>3</sub> particle size distribution and reactivity	19
Soil iron oxides	20
Reactions of iron and carbonate in calcareous soils	21
Reactions of Fe <sup>2+</sup> and Fe <sup>3+</sup> salts with calcium carbonate	21
Bicarbonate as cause of iron chlorosis	2
<b>3- Reactions between iron and phosphate in calcareous systems</b>	23
<b>II : MATERIALS AND METHODS</b>	26
<b>1- Greenhouse and laboratory experiments on iron nutrition and movement in soils</b>	26
A- Greenhouse experiment	26
Soil analysis	27
First Crop	27

Fertilizer Treatments	27
Grain sorghum plants	30
Second Crop	30
B- Laboratory experiment	30
<b>2- Experiments on the role of soil CaCO<sub>3</sub> and soil iron in iron nutrition</b>	<b>31</b>
CaCO <sub>3</sub> particle size distribution	33
Growth Room Study	34
<b>3- Experiments on reactions between iron and phosphate in calcareous systems</b>	<b>36</b>
A- preparation of samples	36
A-1 Reaction of Fe <sup>3+</sup> with H <sub>2</sub> PO <sub>4</sub> <sup>-</sup> under high pH	36
A-2 Reaction of Fe <sup>3+</sup> with H <sub>2</sub> PO <sub>4</sub> <sup>-</sup> in the presence of CaCO <sub>3</sub>	37
B- Mineral analysis	38
X-ray Diffraction (XRD)	38
Transmission Electron Microscopy (TEM)	38
Scanning electron microscopy (SEM) and energy dispersive x-ray analysis (EDXRA)	39
DTPA-extractable Fe	39
<b>III : RESULTS AND DISCUSSION</b>	<b>40</b>
<b>1- Greenhouse and laboratory experiments on iron nutrition and movement in soil</b>	<b>40</b>
A- Greenhouse experiment	40
Plants	40
Yield	40
Iron	43
Manganese	46
Zinc	48
Soils	50
Iron	50
Manganese	55
Zinc	55
Phosphorus	55
B- Laboratory experiment	58
Iron	58

Manganese	61
Zinc	63
Soil pH	63
<b>2- The role of soil CaCO<sub>3</sub> and soil iron in iron nutrition</b>	<b>66</b>
1- Determination of the effective particle size distribution of soil carbonate by using steady-state procedure	68
Rate constants	68
Effective particle size distribution	68
2- The indigenous soil factors that influence iron availability	70
Soil iron oxide phase	77
Soil DTPA-extractable Fe	80
Soil CaCO <sub>3</sub>	82
Soil pH	83
<b>3- Reactions between iron and phosphate in calcareous systems</b>	<b>84</b>
Powder x-ray diffraction	84
Fe-containing compounds formed under high pH	84
Fe-containing compounds formed in under calcareous system	85
Transmission electron microscopy (TEM)	91
Scanning electron microscopy (SEM) and energy dispersive x-ray analysis	91
DTPA-extractable Fe as affected by P:Fe molar ratio	96
<b>IV : CONCLUSIONS</b>	<b>103</b>
<b>SUMMARY</b>	<b>105</b>
<b>REFERENCES</b>	<b>109</b>
<b>APPENDIX</b>	<b>129</b>
<b>ARABIC SUMMARY</b>	