Preface

Soil fertility and plant nutrition principles are the two primary subjects discussed in this book, presenting the reader with what would have been learned in basic as well as advanced soil fertility and plant nutrition college courses. The topics discussed are presented in such a manner that the reader can, with minimum basic background knowledge, feel confident applying the principles presented to his own soil/crop production system. The information in this book can be used as a means for searching particular topics by subject matter. In addition, this book contains sufficient fundamental information so that there is no need to search other sources unless there are specific issues associated with a particular soil-plant system that is not covered in this book, or more detailed factual information is desired.

The book is divided into two sections:

- Chapters that discuss the fundamental principles of soil and crop fertility management.
- Subject matter sections that deal with specific topical subjects.

HISTORICAL BACKGROUND

Today, not many agricultural land-grant universities and colleges offer basic or advanced instruction on soil fertility and plant nutrition subjects applicable to the practical management of soils and crops. Research conducted at experiment stations and research centers within this land-grant system have in the past provided information needed by farmers and growers to keep pace with changing technology. This information was transferred through the Land-Grant Cooperative Extension Service in either written publications or by presentations given in seminars and instructional programs conducted by state specialists or local county agents. Although a portion of this system is still intact in some states, many land-grant institutions have significantly reduced their outreach programs dealing with soil fertility and plant nutrition subjects. Therefore, those who had relied on these institutions in the past have had to seek other sources for information essential for success in soil fertility management and crop production.

As soil and crop management procedures have become more complex, county agricultural agents, farm advisors, fertilizer and chemical dealers, as well as consultants have had to specialize in some aspect of soil fertility and crop nutrition management procedures, limiting their ability to provide a range of advice and services. Most farmers and growers can no longer turn to just one source for the information and instruction needed to achieve their production goals.

DEFINITIONS AND JARGON

As with any subject, particularly one associated with a specific scientific field, there develops a jargon that is easily recognized by the practitioners but may be confusing

to the learner and even those working in this field. For example, in the early 1950s, liquid forms of nitrogen-containing fertilizers were coming into use with "liquid nitrogen" as the defining words for such fertilizers. While listening to a farm advisory program that talked about how best to apply a "liquid nitrogen" fertilizer to one's lawn, a scientifically trained listener wondered how in the world one would apply liquid nitrogen, which to him, is a liquefied gas that has a temperature of minus 209°C, and would be both difficult and dangerous to handle without the proper equipment.

In this book, when there can be two or more possible meanings for a word or phrase, there is provided an explanation so that no such confusion occurs as was noted above with the use of the phrase "liquid nitrogen." Some of the common terms used in the past, and even in the current literature, can be confusing. For example, words such as nutrition, nutrient, nutrient element, essential element, mineral or mineral element, metal, etc., to some may be synonymous, or have a variety of meanings depending on the context. When such words are used in the text, their specific definition as applied to soil fertility and plant nutrition subjects is given. A glossary of general terms, together with those terms specific to the subject of soil fertility and plant nutrition, appears in Appendix A.

ABBREVIATIONS

To make the text easier to read, appropriate and commonly used abbreviations are used unless there is a potential for confusion or misunderstanding in some contexts. Units of measurement, weight, volume, etc., are given mostly in British units or where the metric or other units are specific for that parameter, or that which is in common use. In most of the sections, tabular data are used with a minimum of verbiage, making the essential information more easily identified and applied. The following are the abbreviations used in the text for elements, compounds, ionic forms, and units of measure.

Elements and Their Symbols

Element	Symbol
Aluminum	Al
Arsenic	As
Boron	B
Cadmium	Cd
Calcium	Ca
Carbon	C
Chromium	Cr
Chlorine	Cl
Cobalt	Co
Copper	Cu
Hydrogen	H
Iron	Fe
Lead	Pb
Lithium	Li
Magnesium	Mg

Manganese	Mn
Mercury	Hg
Molybdenum	Mo
Nickel	Ni
Nitrogen	N
Oxygen	O
Phosphorus	P
Potassium	K
Selenium	Se
Silicon	Si
Sodium	Na
Strontium	Sr
Sulfur	S
Titanium	Ti
Vanadium	V
Zinc	Zn

Compound	Elemental Formula
Ammonia	NH_3
Ammonium molybdate	$(NH_4)_6Mo_7O_{24}{\cdot}4H_2O$
Ammonium nitrate	NH_4NO_3
Ammonium sulfate	$(NH_4)_2SO_4$
Borax	$Na_2B_4O_7{\cdot}10H_2O$
Boric acid	H_3BO_3
Calcium carbonate	$CaCO_3$
Calcium chloride	$CaCl_2{\cdot}4H_2O$
Calcium nitrate	$Ca(NO_3)_2{\cdot}4H_2O$
Calcium sulfate	$CaSO_4{\cdot}2H_2O$
Carbon dioxide	CO_2
Copper sulfate	$CuSO_4{\cdot}5H_2O$
Diammonium phosphate	$(NH_4)_2HPO_4$
Hydrochloric acid	HCl
Ferric sulfate	$Fe_2(SO_4)_3{\cdot}4H_2O$
Ferrous ammonium sulfate	$(NH_4)_2SO_4{\times}FeSO_4{\cdot}6H_2O$
Ferrous sulfate	$FeSO_4{\cdot}7H_2O$
Magnesium carbonate	$MgCO_3$
Magnesium sulfate	$MgSO_4{\cdot}7H_2O$
Manganese oxide	MnO
Manganese sulfate	$MnSO_4{\cdot}4H_2O$
Monoammonium phosphate	$NH_4H_2PO_4$
Nitric acid	HNO_3
Phosphoric acid	H_3PO_4
Potassium chloride	KCl
Potassium nitrate	KNO_3
Potassium sulfate	K_2SO_4
Silica	SiO_2
Sodium molybdate	$Na_2Mo_7O_{24}{\cdot}7H_2O$

Sodium nitrate	$NaNO_3$
Sulfuric acid	H_2SO_4
Urea	$CO(NH_2)_2$
Zinc sulfate	$ZnSO_4 \cdot 7H_2O$

Ionic Forms

Element	Elemental Formula	Valance
Aluminum	Al^{3+}	
Ammonium	NH_4^+	
Borate	BO_3^{3-}	
Chloride	Cl^-	
Calcium	Ca^{2+}	
Copper	Cu^{2+}	
Iron (ferrous, ferric)	Fe^{2+} and Fe^{3+}	
Magnesium	Mg^{2+}	
Manganese	Mn^{2+}	
Molybdate	MoO^{3-}	
Nickel	Ni^{2+}	
Dihydrogen phosphate	$H_2PO_4^-$	
Monohydrogen phosphate	HPO_4^{2-}	
Orthophosphate	PO_4^{3-}	
Potassium	K^+	
Nitrate	NO_3^-	
Nitrite	NO_2^-	
Sodium	Na^+	
Silicate	SiO_4^-	
Sulfate	SO_4^{2-}	
Vanadate	VO_4^{3-}	
Zinc	Zn^{2+}	

Units of Measure

Unit	Abbreviation
Area	
Acre	A
Hectare	h
Square meter	m^2
Volume	
Cubic centimeter	cc
Liter	L
Milliliter	mL

Distance	
Feet	ft
Yard	y
Meter	M
Decimeter	dm
Centimeter	cm
Millimeter	mm
Weight	
Milligram	mg
Gram	g
Kilogram	kg
Pound	lb
Concentration	
Parts per million	ppm
Milligrams per liter	mg/L

THE INTERNET

Today the Internet offers a wide range of information, usually specific to a particular region, soil, and crop. Those turning to the Internet must be able to comb through numerous websites to find the information and instructions applicable to their particular soil/crop production system. In addition, they must be able to identity that information found to have application to their individual circumstances and conditions. One good clue for assessing the value of the information provided is to observe the date posted on the Internet and when last updated. The information in this book can be used for verification of information that has been posted on websites that either complements or adds additional information to the subject.