

Plant nutrition for food security

A guide for integrated nutrient management



Contents

Preface	ix
Acknowledgements	x
List of abbreviations and acronyms	xi
1. Introduction	1
Present and future demands for plant nutrients in developing regions	2
2. Food security and agricultural production	5
Striving for food security	5
Food security for a growing world population	7
Food production prospects in developing countries	11
Problems and possibilities	14
Demands on agriculture for providing food security	17
Nutrients in production and consumption cycles and nutrient transfers	19
3. Plant nutrients and basics of plant nutrition	25
Plant nutrients	25
Nutrients – their functions, mobility in plants and deficiency/toxicity symptoms	27
Basics of plant nutrition	34
Root growth and nutrient uptake	40
Efficient use of nutrients	42
4. Soil fertility and crop production	43
Soils as a basis for crop production	43
Soil constituents	45
Soil properties and plant requirements	49
Nutrients in soils and uptake by plants	60
Dynamics of plant nutrients in soils	65
Dynamics of major nutrients	66
Assessment of available nutrient status of soils and plants	74
Impact of soil fertility on crop productivity	83
Fertility management of soils in different climate regions	85

5. Sources of plant nutrients and soil amendments	91
Mineral sources of nutrients (fertilizers)	92
Organic sources of nutrients	119
Biofertilizers (microbial inoculants)	130
Soil amendments	136
6. Optimizing plant nutrition	141
General aspects	141
Basic information for optimizing crop nutrition	148
Strategies for optimizing nutrient management	164
Integrated nutrient–water management for optimizing plant nutrition	167
Plant nutrition and resistance to stress	174
Nutrient management in different cropping systems	177
Optimizing nutrient management in dryland and irrigated farming	186
7. Guidelines for the management of plant nutrients and their sources	193
Preconditions for successful nutrient management	193
Guidelines for nutrient management through fertilizers	196
Guidelines for fertilizer application	208
Guidelines for the application of organic manures	223
Guidelines for the application of biofertilizers	226
Application of soil amendments	232
8. Nutrient management guidelines for some major field crops	235
Cereals and millets	235
Grain legumes	243
Oil crops	244
Root and tuber crops	251
Sugar crops	255
Fibre crops	258
Pastures	260
9. Economic and policy issues of plant nutrition	263
Factors affecting decision–making	263
Economics of fertilizer application	269

Economics of organic manures and biofertilizers	273
Policies for effective plant nutrition	274
10. Plant nutrition, food quality and consumer health	281
General aspects	281
Plant nutrition and product quality	285
Consumer health issues and food quality	292
11. Plant nutrition and environmental issues	299
Basic effects of nutrient management on the environment	299
Environmental aspects of plant nutrients	302
Minimizing the negative environmental effect of nutrient use	310
Glossary	315
Bibliography	339
Units and conversion factors	347