Contents

Preface, vii

Units of Measurement and Abbreviations used in this Book, ix

Part I The Soil Habitat

I Introduction to the Soil, 3

- 1.1 Soil in the making, 3
- 1.2 Concepts of soil, 3
- 1.3 Components of the soil, 8
- 1.4 Summary, 9

2 The Mineral Component of the Soil, 11

- 2.1 The size range, 11
- 2.2 The importance of soil texture, 14
- 2.3 Mineralogy of the sand and silt fractions, 16
- 2.4 Mineralogy of the clay fraction, 22
- 2.5 Surface area and surface charge, 29
- 2.6 Summary, 31

3 Soil Organisms and Organic Matter, 34

- 3.1 Origin of soil organic matter, 34
- 3.2 Soil organisms, 37
- 3.3 Changes in plant remains due to the activities of soil organisms, 46
- 3.4 Properties of soil organic matter, 49
- 3.5 Factors affecting the rate of organic matter decomposition, 52
- 3.6 Summary, 56

4 Peds and Pores, 59

- 4.1 Soil structure, 59
- 4.2 Levels of structural organization, 60

- 4.3 Soil micromorphology, 64
- 4.4 The creation and stabilization of soil structure, 67
- 4.5 Soil porosity, 72
- 4.6 Summary, 76

Part 2 Processes in the Soil Environment

- 5 Soil Formation, 81
 - 5.1 The soil-forming factors, 81
 - 5.2 Parent material, 83
 - 5.3 Climate, 90
 - 5.4 Organisms, 93
 - 5.5 Relief, 95
 - 5.6 Time, 98
 - 5.7 Summary, 99

6 Hydrology, Soil Water and Temperature, 103

- 6.1 The hydrologic cycle, 103
- 6.2 Properties of soil water, 107
- 6.3 Infiltration, runoff and redistribution of soil water, 112
- 6.4 Soil water retention relationship, 119
- 6.5 Evaporation, 122
- 6.6 Soil temperature, 127
- 6.7 Summary, 129

7 Reactions at Surfaces, 133

- 7.1 Charges on soil particles, 133
- 7.2 Cation exchange, 141
- 7.3 Anion adsorption and exchange, 147
- 7.4 Particle interaction and swelling, 149

- 7.5 Clay-organic matter interactions, 152
- 7.6 Summary, 154

8 Soil Aeration, 158

- 8.1 Soil respiration, 158
- 8.2 Mechanisms of gas exchange, 160
- 8.3 Effects of poor soil aeration on root and microbial activity, 164
- 8.4 Oxidation-reduction reactions in soil, 169
- 8.5 Summary, 172

9 Processes in Profile Development, 176

- 9.1 The soil profile, 176
- 9.2 Pedogenic processes, 179
- 9.3 Freely drained soils of humid temperate regions, 185
- 9.4 Soils of the tropics and subtropics, 188
- 9.5 Hydromorphic soils, 192
- 9.6 Salt-affected soils, 195
- 9.7 Summary, 197

10 Nutrient Cycling, 200

- 10.1 Nutrients for plant growth, 200
- 10.2 The pathway of nitrogen, 202
- 10.3 Phosphorus and sulphur, 211
- 10.4 Potassium, calcium and magnesium, 219
- 10.5 Trace elements, 221
- 10.6 Summary, 226

Part 3 Soil Management

11 Maintenance of Soil Productivity, 233

- 11.1 Traditional methods, 233
- 11.2 Productivity and soil fertility, 238
- 11.3 Soil acidity and liming, 242
- 11.4 The importance of soil structure, 245

- 11.5 Soil erosion, 251
- 11.6 Summary, 259

12 Fertilizers and Pesticides, 264

- 12.1 Some definitions, 264
- 12.2 Nitrogen fertilizers, 264
- 12.3 Phosphate fertilizers, 271
- 12.4 Other fertilizers including
- micronutrient fertilizers, 277
- 12.5 Plant protection chemicals in soil, 2
- 12.6 Summary, 287

13 Problem Soils, 291

- 13.1 A broad perspective, 291
- 13.2 Water management for salinity control, 291
- 13.3 Management and reclamation of salt-affected soils, 301
- 13.4 Soil drainage, 305
- 13.5 Summary, 309

14 Soil Information Systems, 314

- 14.1 Communication about soil, 314
- 14.2 Traditional classification, 315
- 14.3 Soil survey methods, 317
- 14.4 Soil information systems, 324
- 14.5 Summary, 329

15 Soil Quality and Sustainable Land Management, 333

- 15.1 What is soil quality? 333
- 15.2 Concepts of sustainability, 335
- 15.3 Sustainable land management, 339
- 15.4 Summary, 344

Answers to questions and problems, 348

Index, 354