

Principles and Practice of Soil Science

The Soil as a Natural Resource

Fourth Edition

ROBERT E. WHITE



**Blackwell
Publishing**

Contents

Preface, vii

Units of Measurement and Abbreviations used in this Book, ix

Part I The Soil Habitat

1 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, 279
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