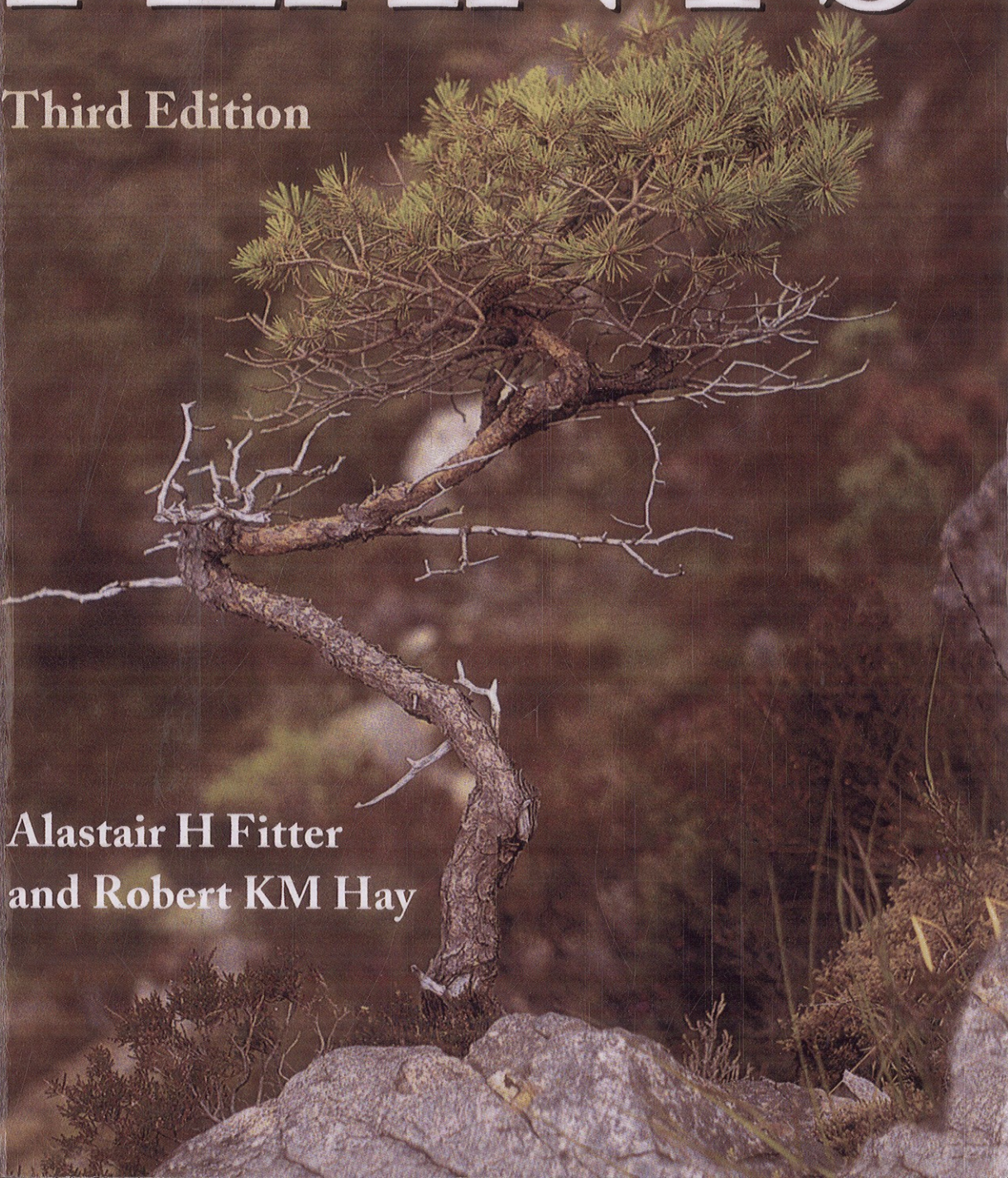


Environmental Physiology *of* PLANTS

Third Edition

Alastair H Fitter
and Robert KM Hay



Contents

Preface to the Third Edition	v
Acknowledgements	vii
1. Introduction	1
1. Plant growth and development	1
2. The influence of the environment	8
3. Evolution of adaptation	14
4. Comparative ecology and phylogeny	17
Part I. The Acquisition of Resources	21
2. Energy and Carbon	23
1. Introduction	23
2. The radiation environment	26
1. Radiation	26
2. Irradiance	26
3. Temporal variation	29
4. Leaf canopies	29
3. Effects of spectral distribution of radiation on plants	33
1. Perception	33
2. Germination	34
3. Morphogenesis	36
4. Placement	38
5. Flowering	42
4. Effects of irradiance on plants	43
1. Responses to low irradiance	43
2. Photosynthesis at high irradiance	57
5. Responses to elevated carbon dioxide concentrations	66
1. Photosynthetic responses	66
2. Whole-plant responses	70
3. Mineral Nutrients	74
1. Introduction	74
2. Nutrients in the soil system	82
1. Soil diversity	82
2. Concentrations	85
3. Ion exchange	87

4. Cycles	90
5. Transport	91
6. Limiting steps	97
3. Physiology of ion uptake	98
1. Kinetics	98
2. Interactions	101
3. Regulation	102
4. Morphological responses	106
1. Root fraction	106
2. Root diameter and root hairs	107
3. Root density and distribution	108
4. Turnover	112
5. Soil micro-organisms	115
1. The nature of the rhizosphere	115
2. Nitrogen fixation	118
3. Mycorrhizas	120
6. General patterns of response to soil nutrients	128
4. Water	131
1. Properties of water	131
2. The water relations of plants and soil	134
1. Water potential	134
2. The water relations of plant cells	135
3. Plant water stress	138
4. Supply of water by the soil	143
5. Loss of water from transpiring leaves	148
6. Water movement in whole plants	153
3. Adaptations favouring germination and seedling establishment in dry environments	157
4. Adaptations favouring survival and reproduction under conditions of water shortage	162
1. Acquisition of water	163
2. Conservation and use of water	167
3. Tolerance of desiccation	180
4. Contrasting life histories in arid environments	183
5. Some special problems in tree/water relations	184
1. Vascular system	186
2. Leaves	188
Part II. Responses to Environmental Stress	191
5. Temperature	193
1. The temperature relations of plants	193
1. The thermal environment of plants	193
2. The temperature relations of plant processes	195
3. Plant development	197
4. Plant growth and metabolism	200
5. Responses to changes in the thermal environment	203

2. Plant adaptation and resistance to low temperature	205
1. The influence of low temperature on plants	205
2. Characteristic features of cold climates: Arctic and Alpine environments, temperate winters	207
3. Adaptations favouring plant growth and development in Arctic and Alpine regions	211
4. Adaptations favouring survival of cold winters: dormancy	224
5. Adaptations favouring survival of cold winters: plant resistance to freezing injury	225
6. Life in a warmer world: the case of the Arctic Tundra	229
3. The survival of plants exposed to high temperatures	231
4. Fire	236
1. The influence of fire on plants and communities	236
2. Life histories in the Kwongan: ephemerals, obligate seeders and resprouters	239
6. Toxicity	241
1. The nature of toxicity	241
2. Toxic environments	241
1. Salt-affected soils	241
2. Calcareous and acid soils	243
3. Metal-contaminated soils	244
4. Waterlogged soils	246
5. Air pollution	247
6. Oxidative damage	248
3. The influence of toxins on plants	248
1. Introduction	248
2. Acquisition of resources	250
3. Utilization of resources	255
4. Resistance to toxicity	259
1. Escape	259
2. Exclusion	262
3. Amelioration	269
4. Tolerance	279
5. Phytoremediation: biotechnology to detoxify soils	279
6. The origin of resistance: the genetic basis	281
7. An Ecological Perspective	285
1. The individual plant	285
2. Interactions among plants	291
1. Mechanisms of competition	291
2. The occurrence, extent and ecological effects of competition	293
3. Interactions between plants and other organisms	298
4. Strategies	304
5. Dynamics	308
References	313

Name Index	347
Species Index	355
Subject Index	358
Colour plate section between pages 180 and 181.	