

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)

## INDEX

Page references in *italics* refer to figures or tables.

- $\epsilon$  (light conversion coefficient) 117, 118  
 $\Phi$  (specific leaf area), 117, 118, 120  
*Abies* spp.  
     *A. alba* 208  
     *A. balsamea* 211–13  
 abiotic environments 81  
 abrin 91  
*Acer pseudoplatanus* cells 46  
 acid phosphatase 69, 140, 141, 146  
 active processes 104  
 ‘adaptive landscapes’ 191  
 adenylate  
     energy charge 16  
     kinase 16  
     metabolism 67  
 Adirondacks 211–13, 219, 221  
 ADP 16  
 ADPG pyrophosphorylase 68, 69, 72  
 aeration, soil 81, 127, 128, 132, 135, 143  
 aerenchyma 135  
 aerial roots 83  
 AFRC wheat model 114, 115  
 Africa, savanna flora 84  
 agriculture 179, 197, 263  
     early 250  
     *see also* cereals; crops; fertilisers  
*Agropyron repens* 178  
*Agrostis tenuis* 8  
 air  
     pollution 207–8, 209, 211, 221, 222  
     temperature 164–5, 235  
*Albizzia harveyi* 88  
 alder 117  
 alfalfa 144  
 algae 24, 34, 35  
 alkaline phosphatase 69  
 alkaloids 91  
 allantoic acid 90  
 allantoin 90  
 allelopathic interactions 81  
 allometry 185  
 Alps 209  
 altitude, high 120  
 aluminium 143, 214  
     tolerance 19  
     toxicity 127, 133, 137  
     uptake inhibition 137  
*Amaranthus viridis* 88  
 amides 87, 90–1  
 amines 91  
 amino acids 85, 112  
     acyl-tRNA 17  
     amino acid:tRNA ligase 17, 18  
     in exudates 137  
     in grain filling 231  
     non-protein 91, 138; *see also*  
         phytosiderophores  
     proportions in proteins 9  
     for protein synthesis 13–14  
     storage 14  
     for turgor 44  
 aminopeptidase 5  
 ammonia 6, 86, 89  
     *see also* ammonium  
 ammonium 85–6, 88–90  
     assimilation 86, 89  
     breakdown 85  
     index of response to 163  
     a nitrogen supply 13, 81  
     in soils 81, 133  
     sulphate 216  
     uptake by mycorrhizae 83  
 AMP 16  
 $\beta$ -amylase 72  
 anaerobiosis 137  
 analysis of variance 99  
 animals, behaviour patterns 177–8  
 annual species 88, 143  
*Anthoxanthum odoratum* 258, 262  
*Anthriscus sylvestris* 258  
 apoplasmic pathway 131  
 aquifers 255

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)270 *Index*

- Arabis hirsuta* 258  
 arctic regions, nitrogen mineralisation 83  
 arginine 90  
*Aribidopsis thaliana* 22  
 'arms race' 181, 184  
*Arrhenatherum elatius* 161–3, 167–73, 258–61  
     *ssp. bulbosus* 171  
 asparagine 90  
 atmospheric nitrogen deposition 207  
 ATP 11, 14, 81  
     ATP/ADP ratio 67  
     effects of iron deficiency on 63, 73  
     in glutamate synthesis 89  
     in phloem loading 64–5  
     and phosphorus supply 16, 65, 66, 73  
     and protein synthesis 17, 18  
 atrazine binding sites 66  
*Atriplex hastata* 88  
 Australia, plant nitrogen 85, 87  
 autecological studies 173, 252  
 autotrophic plants 2, 84  
 auxins 126, 143, 145  
*Avena sativa* 42  
     and manganese deficiency 143  
     roots 34, 35  
*Avenula pratensis* 258  
*Avicennia nitida* 88  
*Azospirillum* 143–4  
  
 bacteria  
     *E. coli* 17  
     see also microorganisms  
 Balsam fir (*Abies balsamea*) 211–13  
 barley, see *Hordeum vulgare*  
 Barnfield experiment, Rothamsted 40, 41  
 Bavarian Forest 208  
 bean 41, 42, 104  
 beech, European (*Fagus sylvatica*) 89, 208, 219  
 behaviour, animal 177–8  
*Betula pendula* 24, 117  
 bicarbonate in soil 136  
 biochemical composition, plant 8–11  
 biological organisation, levels of 100  
 biomass 38  
 biophysics 191  
 birch (*Betula pendula*) 24, 117  
 birds 184  
 Black Forest 208, 211, 214, 219  
 Blackman's Law of Limiting Factors 24  
 boron 4, 19, 132  
*Brassica napus* (oilseed rape) 41, 42, 134, 138  
 bread 229  
 breeding, plant 197–8, 242, 250  
  
 Britain 252–3, 256, 257, 258  
 British Ecological Society 252  
*Briza media* 258, 262  
*Bromus* spp.  
     *B. erectus* 261  
     *B. rigidus* 42  
  
 C<sub>3</sub> and C<sub>4</sub> species 106, 119  
 cadmium 8, 137  
 caffeic acid 138  
 calcicoles 8, 159, 160, 161, 162, 252  
 calcifuges 8, 160, 161, 252  
 calcium 146  
     carbonate 129  
     in cells 46–7; cytoplasmic 36  
     citrate 137  
     concentrations 4  
     in conifers 211, 212, 213, 215  
     foliar 161, 162, 211, 215  
     phosphate 146  
     radial transport 131  
     in the soil 159–63  
     sulphate 129  
     and turgor 44  
     uptake 130, 131  
*Calluna vulgaris* 8  
*Calophyllum brasiliense* 88  
 Calvin cycle (reductive pentose phosphate pathway) 55, 59–60  
 cambium 218, 220  
 CAM (Crassulacean acid metabolism) 37  
*Campanula rotundifolia* 259, 261, 262  
 canopy 21, 120  
     expansion 108, 109  
     optimal nitrogen distribution 110–13  
     photosynthesis 112, 234  
     radiation interception 117  
 carbohydrates  
     for grain growth 230, 232  
     insufficient sinks 65  
     in parenchymal cells 9  
     partitioning 68, 70, 227  
     structural 70–1  
 carbon 1, 2, 4, 180  
     exchange rate 232–3  
     for grain growth 230–2  
     in metabolism 12, 73, 86  
     /nitrogen ratio 10, 90  
     organic, released into the rhizosphere 127, 136–41  
     for parasites 85  
     partitioning 120  
     reserves 71  
     supply and demand 99, 187  
     transport 64–5, 73, 127

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)

## Index

271

- carbon dioxide 2, 61–3, 101, 189, 233  
 assimilation rate of 10, 12  
 regulation of uptake 104
- carbonic anhydrase 6
- Carex flacca* 258
- carnivorous plants 83
- carotene 56
- Casparian band 131
- cassava (*Manihot esculentum*) 145
- cation–anion balance 137
- cation exchange capacity 160
- Cecropia glaziovii* 88
- cells 33, 100  
 ‘average photosynthetic’ 12  
 compartmentation 8, 14, 33, 34, 46–8  
 components 2–3, 8–9  
 of damaged spruce trees 218, 220–2  
 energetics and growth 1, 2, 3, 5, 15–16  
 homeostasis 8, 12–13  
 membrane 4  
 meristematic 33  
 metabolism 11–16  
 nitrate reduction in 86  
 nutrient distribution 34–7  
 parenchyma 9  
 protein and nitrogen 81  
 ray (Strasburger) 221  
 size 22  
 sloughed of 137, 142  
 stomatal 33  
 totipotent 185  
 turnover 21, 105  
 walls 37, 70, 233, 237; calcium for 4
- cellulase 146
- cellulose 8, 70
- Celosia argentea* 88
- Centaureum erythraea* 258
- Cerastium fontanum* 258, 261
- CER (carbon exchange rate) 232–3
- cereals  
 anthesis 115, 229, 231, 242, 243  
 breeding 229, 242  
 grain 227–9; carbon and nitrogen  
 sources for growth 230–3; filling 115,  
 231, 232; nitrogen content 227–8, 232,  
 239–41, 242; nitrogen uptake 232;  
 protein 228–9, 230, 232, 242; quality  
 229, 230, 237, 242, 243; size 229, 230  
 grain yield 227, 229–30, 239, 241–2, 243  
 modelling 233–42  
 potassium concentrations 40, 41
- Chamaenerion angustifolium* 161–3
- chelates of heavy metals 138–41, 142–3
- chemical analyses 2–6  
 soil 125, 214
- chemical elements, *see* nutrients
- Chenopodium* spp.  
*C. album* 88, 159–63  
*C. rubrum* 181
- chickpea (*Cicer arietinum*) 136
- chlorine 5, 6, 46–7
- chlorophyll 3, 9  
 a/b ratio 65  
 chlorophyll–protein complexes 58, 65,  
 66, 73  
 effect of low phosphorus on 66  
 and electron transport 61  
 and iron deficiency 56, 58  
 magnesium for 4
- chloroplasts 33, 57  
 components regulated by light 19  
 effects of low phosphorus 64  
 energy dissipation 21  
 glutamine synthetase 89  
 and iron stress 56, 57, 59  
 nitrogen 110  
 phosphate in 71  
 photosystems, *see* photosystems  
 triose phosphate partitioning in 68
- chlorosis 136, 139  
*see also* yellowing
- Chrysanthemum leucanthemum* 178
- Cicer arietinum* 136
- Cirsium palustre* 195
- citric acid 134, 137
- citrulline 90
- Citrus limonum* 56
- climate 105, 120, 216  
 and growth 168–71, 229
- climax vegetation 81, 90
- clover, white (*Trifolium repens*) 168, 182,  
 258
- Colophospermum mopane* 88
- common mullein (*Verbascum thapsus*) 183
- communities 100, 165, 173, 251, 262
- comparators 102, 103
- compartmental flux analysis 34–5
- competition 117, 180, 184, 263  
 competitive species 21–2
- Compositae 110
- composition, plant biochemical 8–11
- conifers 212  
 needles 209–10, 211, 215, 218–19, 220–1  
 types of forest damage to 207–8  
*see also* under names of individual species
- controlled environments 249
- copper 19, 135, 136, 137, 145  
 chelates 139  
 concentrations 5
- cortex, root 131
- cotton 64, 134
- Crassulacean acid metabolism (CAM) 37

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)272 *Index*

- Crataegus monogyna* 88  
 crops 120  
   agronomy 229, 249–50  
   breeding 143, 197, 250  
   dry matter yield 108  
   growth 99, 106, 119, 234, 237–9;  
     potential productivity 105  
   and nutrient supplies 10–11, 43–6,  
     235–43; nitrogen 82  
   respiration 10  
   *see also* cereals  
 crown 209  
   biomass 219  
*Cryptostemma calendula* 42  
 Cushman, Lake 221  
 cysteine 19  
 cytochrome  
   b 65  
   effect of low phosphorus on 66  
   f 56, 58, 65, 73  
 cytoplasm, *see* cytosol  
 cytosol 34, 36, 68  
   glutamine synthetase 89  
   phosphorus in 16, 68, 69
- Dactylis glomerata* 258, 262  
 damage, pollution 208  
*Danthonia decumbens* 256, 257  
*Datura stramonium* 89  
 daylength 107  
 defoliation 188  
 dehydration 91  
 demography, plant 250–1, 256  
*Dendrophthoe falcata* 84  
 denitrification 135, 235  
 2'-deoxymugineic acid 141  
 Derbyshire Dales 164–7  
*Deschampsia flexuosa* 21, 159–63, 186, 195  
 desert plants 91  
 Desferal, *see* ferrioxamine B  
 development 191  
   and nitrogen shortage 114  
   and temperature 106–7  
 dicotyledons 135, 160  
 dieback 168, 208  
 diffusion 146  
   root exudates 142  
   soil nutrients 125; nitrates 189, 191, 193,  
     197  
*Dimorphandra mollis* 88  
 dinitrogen, *see* nitrogen  
 disease 105, 227, 241  
 diurnal rhythms 199  
   phytosiderophore release 138, 141  
 diurnal temperature 164–7  
 DNA (deoxyribonucleic acid) 1, 13, 22  
 double ridges 115  
 Douglas fir (*Pseudotsuga menziesii*) 211  
*Drosera* 83  
 drought 21, 39, 137, 145, 230, 232  
   and nutrients 232  
 dry-land species 127, 135  
 dry matter 180  
   crops 227  
   for nutrient concentrations 38–9, 118,  
     159, 160, 161  
   production 255; rate 10; root 169, 261;  
     and solar radiation 106, 107  
   in sugar beet 64  
   yield 108  
 DTPA 138  
 dust 208  
 dynamic processes 157
- ecology 249–50  
   biochemical processes and 21  
   developments within 250–3  
   ecological amplitude 256  
   and nitrogen assimilation 87  
   and nutrition 136, 173, 251  
   and plant performance 2–3, 22–6, 87,  
     252, 263  
   strategies in 20–5  
   studies in 256, 263
- ecosystems 100  
   damage to 2, 207; *see also* forests,  
     damage  
   nutrient cycling 184
- ectoenzymes 141  
 edaphic factors, *see* soil  
*Ehrharta longifolia* 42  
 electro-mechanical systems 102–4  
 electron carriers 9, 56  
 electron flow 15  
   and iron deficiency 58, 59, 60–1, 62  
   and phosphorus deficiency 65, 66, 73  
 electron microscopy 56, 59  
 electrophoresis, gel 58  
 elements, cellular 3  
   *see also* nutrients  
 elevations 209  
 Ellenberg's index 163  
 Elzach 214–17  
 endodermis 218  
 energy 15–16, 104  
   cellular 5  
   charge 16  
   light 11  
   solar, *see* solar radiation
- England 254  
 environment  
   aerial and edaphic 2

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)

## Index

273

- biotic 186
- chemical 8, 186
- chemical exchanges between plants and 101
- concentration of elements 4, 7
- experimentally controlled 249
- heterogenous 158, 199
- plant response to 2, 7–8, 99, 157, 177–9, 186, 199
- pollution of, *see* pollution
- enzymes
  - alkaline phosphatase 5
  - ascorbic acid oxidase 5
  - carbonic anhydrase 5, 6
  - co-factors 4–5
  - ectoenzymes 141
  - inhibitors 89
  - leucine:tRNA ligase 18
  - nitrate reductase 5, 164
  - nitrogen demand 82
  - phosphatases 141
  - and phosphorus supply 68, 72
  - photosynthetic 19
  - prosthetic groups 5, 6, 9
  - protection for 91
  - regulation and control 12, 13, 16; by magnesium 3; by phosphorus 64; by potassium 44; by zinc 5
  - salt sensitivity 35
  - for starch and sucrose synthesis 69–70
  - systems 12
  - water splitting 5
  - wheat 17, 18
- epidermal cells, nutrient compartmentation 46–8
- ‘epigenetic landscapes’ 191
- Epilobium hirsutum* 159–63
- Eriophorum vaginatum* 159, 160
- Erodium botrys* 42
- Erythrina* 85
- Escherichia coli* 17
- Euphorbia glomerifera* 88
- Euphrasia officinalis* 258
- Europe 227
  - forest damage 207, 208–11, 222
- eutrophication 253
- evolution 177, 252
- exodermis 131
- extinction coefficient 117, 118
- exudates, root 101, 125, 127–8, 137–41, 142
- Fagus sylvatica* 89, 208, 219
- fats (lipids) 5, 9, 56
- FBP aldolase 65, 68, 69, 72
- FBPase 69–70, 72, 73
- feedback 102–5
- ferns 87, 90
- ferredoxin 56
- ferrichrome 139
- ferricyanide 59
- ferrioxamine B 139, 140
- fertilisers 255
  - crop 113, 182–3, 227, 228, 230, 239–41, 242, 243
  - for forest damage 207, 213–19, 222
  - modelling effects on cereals 234, 235, 236, 239–41
  - nitrogen 113, 240–1, 243
- Festuca* spp.
  - F. myuros* 42
  - F. ovina* 161–3, 168–73, 258, 259, 262
  - F. rubra* 258, 262
- firs, silver (*Abies alba*) 208
- flow meters 102, 103
- foliage, *see* leaves
- foraging, plant 178, 258–9, 263
- forestry, mechanised 253
- forests 81, 90
  - Australian 85, 87
  - Bavarian 208
  - damage: direct and indirect 207–8; extent 208–9; and fertilisers 213–14, 217–19, 222; histological findings 218, 220–2; and magnesium deficiency 213–17; ‘new type’ 207, 208, 209, 217, 222; types and nutritional status 209–13
  - and fertilisers 207, 213–19, 221–2
  - leguminous and non-leguminous 84, 85
  - and mycorrhizae 146
  - nitrate assimilation in 87, 89–90
- fossil fuels 208
- frost 211, 255
- fructose 1, 6-biphosphate 67, 73
  - aldolase (FBP aldolase) 65, 68, 69, 72
- fructose 1, 6-phosphatase (FBPase) 59–60, 68, 69–70, 72, 73
- fructose 2, 6-biphosphate (F2, 6BP) 70
- fructose-6-phosphate 73
- fungi
  - acid phosphatase 141, 146
  - mycorrhizal, *see* mycorrhizae
- fungicides 99, 229
- Gaeumannomyces graminis* 143
- Gallium verum* 262
- game theory 178
- gel electrophoresis 58
- genes 99
  - coding for strategies 177–8
  - control plant size 1, 18

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)274 *Index*

- genes (*cont.*)  
 and environmental adaptation 8  
 frequencies 177  
 gene pool 184  
 genome size 22  
 manipulation 179  
 and mineral tolerance 19–20  
 multigene families 89  
 native species 158  
 and pathogen infection 105  
 and protein synthesis 17–18  
 regulate growth rate 1–2, 18, 119  
 regulate nutritional requirements 18–20  
 transcription and translation 13, 14  
*see also* genotypes
- genetic engineering 2, 179
- genetics, population 1, 251–2
- genetic traits 230, 241
- genotypes 2  
 and environment 177  
 local population 252  
 and roots 146  
 selection 198
- Germany  
 East (German Democratic Republic) 219  
 West (Federal Republic Germany):  
 forest damage 208–11, 222;  
 magnesium deficiency in forests 214–17
- germination 106, 181  
 growth after 168
- Geum urbanum* 195
- Glaucium flavum* 88
- Glomus fasciculatus* 144
- glucose 6-phosphate 67
- glucose 70, 71, 73
- glutamate dehydrogenase 89
- glutamate synthetase 14, 89
- glutamic acid 13
- glutamine 90  
 /glutamate cycle 86  
 synthetase 14, 86, 89, 90
- gluten 228
- glycinebetaine 21, 36, 91
- glycophytes 35
- GOGAT 86
- grain, *see under* cereals
- granite 214
- grasses  
 copper-tolerant 19  
 grown with legumes 145  
 potassium concentrations 40, 41, 42  
 roots: Fe<sup>III</sup> phytosiderophore uptake  
 139–41; response to iron deficiency 138–9  
 ryegrass 131  
 silicon for 3  
 slow-growing 21
- grasslands 166, 181, 256, 257–8
- grass trees 83
- grazing 184, 185  
 grazed grasslands 166  
*see also* herbivores
- green revolution 250
- groundnuts 108, 109
- growth 180, 184  
 ‘balanced’ 187–8; modelling 188–91  
 effects of temperature 17–18  
 nutrient requirements 5, 7, 21, 159–63;  
 ‘critical’ potassium 45; nitrogen, *see*  
*under* nitrogen; phosphorus 63–4  
 and pollutants 207  
 rate, *see* growth rate  
 regulators 228  
 reproductive 99, 119; *see also*  
 reproduction  
 root, *see under* roots  
 root/shoot balance 187–8; *see also*  
 roots, shoot ratio  
 seasonal 167–71  
 strategies 25  
 sugar beet 64  
 tree 207  
 ‘unbalanced’ 188  
 vegetative 99, 181–2; and seed  
 production 182–3
- growth rate 180  
 absolute 117, 180  
 fast and slow growing species 159,  
 168–73, 195–7, 259  
 genetically determined 1–2, 17–18  
 limiting factors 188  
 and mineral nutrition 22–5  
 potential 2, 22, 25, 105–6, 117, 253; and  
 potential reproductive success 183–6;  
 protein synthesis limiting 13; slow-  
 growing species 180–1, 195–7, 253;  
 and soil fertility 21  
 relative 22, 119, 187–91, 193–8, 254;  
 intra-population 181, 182; and nitrate  
 reductase 164; and nutrients 115–16,  
 120, 160, 164, 171–2, 260; and  
 potential reproductive success 180–1  
 and temperature 17–18, 22–5, 106–7
- habitats 178, 253, 254  
 disturbance 258
- haem groups 6
- halophytes 3, 21, 35–6, 91  
*see also* salinity
- Hammelspring–Werderhof 219
- harvests 241  
 index 228
- heat, stress 107

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)

## Index

275

- heavy metals 8, 15, 19–20  
     mucilage complexes 137  
     tolerance 256  
     toxicity 19  
*Helianthemum nummularium* 161–3  
 hemicellulose 70  
 herbaceous plants 20, 197  
 herbicides 229  
 herbivores 184  
     protection against 21, 195–7, 255; by  
     nitrogen 91  
 hexokinase 72  
*Hieracium pilosella* 262  
 histology 221–2  
 Hoagland's solution 63, 160  
*Holcus lanatus* 161–3, 171, 172, 258  
 homeostasis 8, 11, 12–13, 14–15, 25  
 Hoosfield experiment 38  
*Hordeum vulgare* (barley) 227  
     and iron chelates 139, 140, 141  
     malting 229, 242–3  
     mineral compartmentation 35, 46–8  
     nutrient assimilation and uptake 10–11  
     potassium concentration 38–40, 41, 42, 46  
     salt stress 47  
 hormones 4, 126, 146  
 humans causing ecological damage 2, 6, 8, 253  
     to forests, *see* forests, damage  
     *see also* pollution  
 humus 235  
 hydrogen 2, 4, 14, 85  
     bonding 13  
     *see also* pH; protons  
 hydroponics 63, 159, 249  
 hydroxyl ions, from nitrate reduction 85–6  
  
 IMP (inosine 5'-monophosphate) pathway 67  
 'inducible reductase' 135  
 industry 208  
 Ingestadt relation 117  
 inosine 5'-monophosphate pathway 67  
 insecticides 229  
 insects as nitrogen source 83  
 Integrated Screening Programme (ISP) 158, 163, 164  
 interaction 199  
 intercropping 106  
 invertase 72  
 ions  
     compartmentation 14, 34–7  
     in roots 35  
     toxic 207; *see also* heavy metals  
  
 iron 6  
     acquisition 132, 138  
     chelates 136, 138–41  
     concentrations 4  
     deficiency 19, 56–63, 71, 134, 135–6, 138–9, 140  
     and photosynthesis 55, 56–63  
     phytosiderophores 138–41  
     sulphur centres 6, 56  
     toxicity 135  
 irradiance, *see* light; solar radiation  
  
*Juglans nigra* 88  
  
 Kalimagnesia 217  
*Kielmeyera coriacea* 88  
 Kieserite 214  
*Kingia australis* (grass tree) 83  
 K/N (potassium/sodium) ratio 36, 44  
*Koeleria macrantha* 161–3, 261  
  
 Lagrange multiplier 112  
 land, use 157  
 landscapes 252–3  
*Lathyrus* spp.  
     *L. pratensis* 258  
     *L. sylvestris* 88  
 'Law of the Minimum' 188  
 leaching 207, 241, 243  
 lead 8, 137  
 leaves 187  
     area 10, 105, 114, 197, 209, 234; specific 117, 118  
     calcium 161, 211  
     cereal 232–3  
     chlorophyll 58  
     closed forest and pioneer 89–90  
     of competitive species 21  
     components 9, 10  
     glutamine synthetase in 89  
     in the grass tree 83  
     growth 59, 73, 106–7  
     light absorption and iron deficiency 58, 59  
     loss 208, 209, 222  
     nutrients 211, 253, 254; nitrogen 10, 81, 110–13, 211, 232–3, 253; phosphorus 69  
     primordium 106  
     senescence 114, 115, 232  
     shading 113, 117, 120, 181, 188  
     shape 195  
     structure, and iron stress 59  
     temperature 166  
 legumes 90, 145, 229, 258  
     nitrogen content 84, 85  
     rhizosphere acidification 133

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)276 *Index*

- Lemna* spp.  
*L. gibba* 67  
*L. minor* 193  
 lemons (*Citrus limonum*) 56  
*Leontodon hispidus* 258, 262  
 leucine:tRNA ligase 18  
 LHCII 66  
 light 11  
   absorption and phytochemistry 58  
   conversion coefficient 106, 108, 117  
   effects 19  
   excess 21  
   interception 105, 108, 234  
   limit for photosynthesis 61, 62  
   scattering 58  
   see also solar radiation  
 limestone  
   Carboniferous 166  
   dolomitic 213  
 liming 160, 217–19  
 limiting factors 24, 188  
 lipids 5, 9, 56  
   thylakoid membrane 56  
 loaves, bread 228  
*Lolium* spp.  
*L. perenne* 161–3, 258  
*L. rigidum* 42  
*Lotus corniculatus* 258  
 Lower Frankonia 217  
 Lower Saxony 219, 221  
 lupins, white (*Lupinus albus*) 126, 134, 137–8  
*Lupinus albus* 126, 134, 137–8  
 Lutterberg 221  
 luvisol 133  
*Luzula campestris* 258  
 macro- and micro-nutrients 3–6, 19–20, 108–10  
 macrophytes 197  
 magnesium 3, 4, 222  
   cytoplasmic 36  
   deficiency 19, 209, 211, 213–17, 219, 220–1  
   lime containing 217  
   and protein synthesis 14  
   uptake of 130, 131, 134; impeded 216–17  
 maize, see *Zea mays*  
*Malaisia scandens* 88  
 malate 37  
 maltase/maltose phosphorylase 72  
 mammals, grazing 184  
   see also herbivores  
 manganese 6, 215  
   effect of iron 60, 135–6  
   in the soil 132, 134, 138, 143; chelates 139  
   toxicity 135, 136, 143  
*Manihot esculentum* 145  
 manure 163  
 mass flow 125, 128, 146, 189  
 maturity, and temperature 106  
 mechanical impedance 127  
*Medicago* spp.  
*M. lupulina* 258  
*M. tribuloides* 42  
 membranes 44  
   protection by nitrogen 91  
   transport systems 45  
   see also plasma membrane  
 meristematic cells 33, 36  
 metabolic pools 34  
 metabolism 1, 2, 3, 12, 15–16  
 metallothionein proteins 19  
 methionine, radioactive 15  
 microbes, see microorganisms  
 microelectrodes 46  
 micro-nutrients 5  
   see also under nutrients  
 microorganisms 6, 81, 125, 127–8, 137  
   phosphatases 141  
   respiration 135  
   siderophores 141  
 millet 106, 107  
 mineral composition of plants 8–11  
 mineralisation 216, 235, 259  
 minerals in soils 255, 263  
   acquisition by plants 125, 146; dry soils 137; root growth 125–7; see also roots  
   concentrations 127–31  
   deficiency 129–30, 158–65, 207, 251; and forest damage 210, 213–19, 221–2  
   foraging by plants 258–9, 263  
   gradients 127–31  
   leaching 207, 241, 243  
   mobility 125, 129, 207  
   patchiness 259, 263  
   pulses of 259, 260, 263  
   strategies of capture 258–9  
   weathering 129  
   see also nutrients; rhizosphere; soil  
 mistletoe 84  
 mitochondria 33, 56  
 models 99–100  
   balanced growth 188–91  
   crops AFRC wheat 115  
   crop yields 230, 233–4, 237–42  
   growth and nutrient requirement 11  
   growth rates 189–91, 193–9  
   mechanistic 100  
   of nitrogen 113, 233–42



Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)

## Index

277

- nutrient-limited productivity 120
- phenotypic plasticity 188–99
- plant performance 102–4
- roots 187
- molecules 100
- molybdenum 5, 19, 133
  - phosphorylated pterin–protein complex 19
- Monochrysis lutheri* 24
- monocotyledons 135, 160
- monocultures 181–3
- moraine soils 211
- mortality, selective 183–4
- mosaics, vegetation 253
- mucilage 137
- mugineic acid 139
- mutants 19
- mycelia, mycorrhizal 145
  - see also mycorrhizae
- mycorrhizae 89, 144–6, 259–63
  - ectomycorrhizae 83, 145
  - endomycorrhizae 145
  - ericoid 83
  - orchid 83
  - vesicular–arbuscular 83, 145, 262
- NADPG 6-phosphate dehydrogenase 72
- NADP-glyceraldehyde 3-phosphate dehydrogenase 60, 65, 67, 72, 73
- NADPH 11, 12, 63, 67, 73
  - NADPH/NADP ratio 67
- natural selection 180
- natural systems 157
- Neolitsea dealbata* 88
- Netherlands 211, 237, 239
- nettles (*Urtica dioica*) 21, 88, 161–3, 261
- networks 102
- Neubrandenburg 219
- Nitella* spp., ion compartmentation 35
- nitrate reductase 19, 90, 163, 164
  - plant distribution 88
  - role 85, 86
  - root, and rhizosphere pH 133
- nitrites 6, 19
  - affecting balanced growth 188–9, 190, 192
  - ‘compensation point’ 191
  - and growth rate 46
  - microelectrodes sensitive to 46
  - reduction 85–90
  - soil 132, 191, 196–7, 198, 241; leaching 229
  - stored 13–14, 46, 90–1
  - uptake 104, 191, 195, 232; by mycorrhizae 83
- nitrification 81, 216
- nitrite reductase 85, 86
- nitrites 19
- nitrogen 3, 108, 263
  - acquisition 81, 82–5, 192, 259
  - allocation 90–1, 92, 119
  - ammonia as the source 81
  - assimilation 81, 85–90, 92, 191, 232, 234–5
  - atmospheric deposition 207, 211
  - concentrations 4; on the basis of tissue water 43; leaf 81, 110–13, 211, 232–3, 253, 254; and plant dry weight 113, 118; in plants under stress 91; and relative growth rate 115–16; in spruce needles 215, 216
  - in damaged forests 213, 214, 216
  - deficiency 126, 159, 230
  - demand for 92, 243; between species 84; in crops 11, 234–9, 243
  - deposition 207
  - in dry matter 11, 113
  - ‘ecology’ 82
  - in ecosystems 36, 82–5, 168
  - fertilisers 216–17, 227, 236, 240–1, 243
  - fixation 84, 89, 101, 132, 143, 145; site 85
  - in grain 227–8, 232, 239–43
  - and growth 99, 113–19, 120, 159, 190–1; grain 232
  - harvest index 228
  - index of nitrophily 163
  - and nitrate diffusivity 196
  - oxides of 6
  - partitioning 227, 241
  - and photosynthesis 81, 88, 90, 110–13, 232
  - protection by 91
  - in proteins 6, 11
  - pulse exploitation 171–3
  - residual (structural) 233, 237, 242
  - Rubisco containing 82
  - soil 132, 193–5, 235, 259; uptake 196–7, 239–42
  - species response 162–3
  - to magnesium ratio 216–17
  - transport 90, 230, 232, 235
  - see also nitrates
- nitrogenase 144
- nitrophilous species 84, 89, 162–3
- nodules 89, 145
- North America, forest damage 207, 211–13, 221, 222
- Norway spruce (*Picea abies*) 130, 133, 134, 208–22
- nuclear magnetic resonance 45
- nucleic acids 4, 5, 19

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)278 *Index*

- nucleoside diphosphate sugars 70
- nucleus 13
- nutrients 10, 19–20, 255
  - absorption 6–8, 101, 104
  - acquisition 125
  - analysis 212
  - available 125, 230
  - and biochemical composition 2–6
  - cell composition 8–11
  - compartmentation between cells 46–8
  - concentrations 159; critical 14, 119; depletion 158–65; expression in whole plants 38–43; potassium 15; and relative growth rate 115–16
  - crop response to changing supply 43–6, 47, 233–42
  - cycling 184
  - effects on growth, *see under* growth
  - environment supply of 1, 158–65, 199; *see also* minerals in soils
  - fluxes of 8, 104
  - interchangeable 3
  - limiting 99, 108–10, 120; and phenotypes 193
  - micro- and macro- 3–6, 19–20, 108–10
  - mobility 222
  - in native species 158
  - and needle necrosis 209–11
  - partitioning 120
  - pulses 171–3, 259
  - requirement 2–6, 8, 21, 108–10, 119–20; genetic regulation 19–20; and growth rate 21
  - soil, *see* minerals in soils
  - and stress 46, 48
  - tissue and plant composition 10–11
  - toxicity 23
  - transport 8
  - see also* minerals in soils; nutrition
- nutrition 2, 249
  - ecophysiological aspects 157–73
  - and genetic control 8
  - see also* minerals in soils; nutrients
- oak (*Quercus* spp.) 208
- oats, *see Avena sativa*
- Oden Forest 217
- oils 9
- oilseed rape 41, 134
- ontogeny 185
- optimisation 185
  - fertiliser 118
  - nitrogen distribution 113
- organelles 33, 100
- organic acids 14, 137, 142, 143
- organic molecules 3, 4
- organs 100, 120
  - initiation and development 100
- Ornithopus sativus* 42
- orthophosphate ( $P_i$ ) 16, 55, 71, 72
  - in leaf tissue 17
  - role in carbon partitioning 68–71
- translocator 56, 68, 71
- osmosis 21, 36, 91
  - role of potassium 44, 108
- oxalic acid 146
- oxidation, chemical elements for 4
- oxygen 2, 4, 135
  - electrodes 59
- ozone 219, 221
- $P_{700}$  58, 60
- Pack Forest 219
- parasites, and nitrogen 84–5
- parenchyma cells 9
- partitioning
  - assimilates 56, 120
  - nutrient 120
- partitioning coefficient 108
- pathogens 105, 143, 180
- Peak District National Park 166
- pea roots 45–6
- pectic substances 4, 70
- pedotubules 129
- Penman method 235
- pentose phosphate pathway, reductive 55, 59–60
- peptides 91
- perennial species 20, 129, 251, 253
  - and nitrate reduction 87, 88
- peroxisomes 33, 56
- pests 117, 227
  - control 250
- petiole nodules 85
- PFD, *see* photons, flux densities
- PGA, *see* 3-phosphoglycerate
- pH
  - and nitrate reduction 87, 88
  - cytosol and organelle 14
  - rhizosphere 126, 127–8, 132–4, 137–8, 143
  - soil 81
- phenolics 137, 138
- phenology 165
- phenotypes 1, 99, 192
  - expression 178, 191; and nutrient deficiency 193
  - ‘extreme plant’ 197, 198
  - ‘landscape’ 190, 191, 193, 195, 199
  - plasticity 177, 178, 187–98
  - ‘standard plant’ 189, 191–2, 197, 198
  - strategies 180, 186
  - variation 1

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)

## Index

279

- phloem 218–19, 220–2  
   sieve cells 219, 221
- phosphatases 71  
   acid 69, 141  
   alkaline 69, 141  
   bacterial 141
- phosphate 17, 25; *see also*  
   orthophosphate; phosphorus
- phosphoenolpyruvate carboxylase 44
- phosphoglucumutase 72
- 3-phosphoglycerate (PGA) 63, 65, 73  
   kinase 65, 67, 72, 73
- phosphohexoisomerase 72
- phospholipids 9, 16, 17
- phosphorus 110, 255, 263  
   acquisition 127, 132, 145  
   concentrations 5, 17; on the basis of  
     tissue water 43; cytoplasmic 36; in  
     leaf tissue 17, 63, 69, 254; in spruce  
     needles 215  
   deficiency 63–72, 126, 134, 137, 141;  
     adaptation to 71; and mycorrhizae  
     145  
   inorganic 141; *see also* orthophosphate  
   organic 141  
   and photosynthesis 63–71  
   in the rhizosphere 127, 129, 130, 141,  
     144  
   supply and growth 7, 16, 17, 21, 120,  
     126, 168  
   *see also* orthophosphate; phosphate
- phosphorylase 72
- phosphorylation 67
- photochemical conversion 61  
   efficiency 120
- photochemical energy 62, 91
- photoinhibition 21, 71, 91
- photons 2  
   average radiation flux 10  
   flux densities (PFDs) 58, 61; effects of  
     low P 64  
   flux (PF) 188, 190–8
- photoperiod 182, 235
- photorespiration 33, 89  
   and glutamine synthetase 89  
   nitrogen flux 86
- photosynthates  
   consumption of 127, 234; by infecting  
     microorganisms 145  
   crop 230, 232  
   root competition for 126
- photosynthesis 2, 101  
   ‘average photosynthetic cell’ 12  
   C<sub>3</sub> and C<sub>4</sub> species 106  
   electron transport 58, 60–1, 65  
   enzymes 19  
   of ferns 90  
   and grain demand 230  
   iron and 56–63, 73  
   light-saturation 61, 62  
   nitrogen and 81, 88, 90, 110–13,  
     232  
   in parasitic plants 84–5  
   phosphorus and 63–71, 73  
   pigments 19  
   quantum yield 66  
   rate 10, 60–1, 197; and grain yield 237;  
     maximum 110, 111, 112–13; nitrogen  
     and 110, 111  
   slowed 21  
   sugar beet 62  
   ‘units’ 58  
   water splitting 56  
   and water stress 91
- photosynthetically active radiation (PAR)  
   61
- photosystems  
   I 56, 58, 65, 66, 73  
   II 5, 6, 56, 58, 65, 66, 73  
   I/II fluorescence 65
- phylogeny 185
- phytase 146
- phytochelatins 19
- phytochrome system 19, 20
- phytohormones 126
- phytosiderophores 138–41, 142, 146
- Picea* spp.  
   *P. abies* (Norway spruce) 130, 133, 134,  
     208–22  
   *P. pungens* (white spruce) 221  
   *P. rubens* (red spruce) 211–13
- Pimpinella saxifraga* 258
- pine (*Pinus sylvestris*) 208
- Pinus* spp.  
   *P. ponderosa* 143  
   *P. sylvestris* 208
- pioneer species 87, 90
- Pisum arvense* 42, 45–6
- Plantago* spp.  
   *P. lagopus* 88  
   *P. lanceolata* 161–3, 258, 262  
   *P. major* ssp. *major* 21  
   *P. major* ssp. *intermedia* 21–2  
   *P. maritima* 21
- plants  
   ‘standard’ 189  
   strategy theory 258–9
- plasma membrane 44  
   Fe<sup>III</sup> phytosiderophore transport 139,  
     141
- plasticity, phenotypic 177, 178, 187–98
- plastocyanin 5

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)280 *Index*

- Poa* spp.  
*P. annua* 161–3, 186, 258  
*P. pratensis* 262  
*P. trivialis* 258, 261  
 podosol (brown earth) 133  
 polder soil 239  
 pollinators 185  
 pollution 8, 101, 157  
   air 207–8, 209, 211, 221, 222  
   damage to plants 6, 207; *see also*  
     forests, damage  
   and soil nitrogen 163, 243  
   water 255  
 polyphosphates 145  
 polysaccharides 70  
*Polyscias elegans* 88  
 populations 100, 250, 256  
   genetics 1, 251–2  
   genotypes 252  
   grazed 184  
   mineral tolerance of subpopulations 8  
   monocultures 181, 183–4  
   potential growth rate in 181–2, 184–5  
   strategies in 178  
 potassium 3, 108, 215  
   in barley shoots 38, 39–40  
   compartmentation 34, 35, 37  
   concentrations 4, 38–45; in the  
     cytoplasm 44–5; vacuolar 37, 44, 45  
   ‘critical’ 45  
   deficiency 19, 45, 213, 221, 222  
   depresses magnesium uptake 131  
   in dry matter 38, 39  
   potassium/sodium ratio 36, 44  
   and protein synthesis 14, 15  
   in soil 129, 130, 131, 132, 219; non-  
     exchangeable 129  
   turgor generation 37  
 potatoes 106, 107, 108, 110, 113–15, 119  
 potential difference, plasma membrane 44  
 precipitation 214  
 predation 255  
 productivity 105–6, 120  
   *see also* growth rate  
 prolamins synthesis 242–3  
 proline 36, 91  
 Proteaceae 83  
 protease 146  
 proteins 6  
   broken down for new growth 10  
   in grain 228–9, 230, 232, 242  
   hydrolysis for grain growth 232  
   metallothionein 19  
   and nitrogen 4, 6, 13–14, 111–12  
   proportions in cell types 9  
   synthesis 1, 6, 13–14, 15–17; ionic  
     environment 14, 15; in required  
     amounts 19; and temperature 17–18  
 protons 132, 135, 137, 207  
   from ammonium 85  
*Prunella vulgaris* 258  
*Pseudotsuga menziesii* 211  
 PSI and PSII, *see under* photosystems  
 Pteridophyta 256  
 pterin 19  
 pump analogy 102, 105  
 pyridine nucleotides 16, 85  
 pyrimidine synthesis 15  
 pyrophosphatase 68  
 pyruvate amino transferase 86  
 Q (electron transport component) 60  
 quality, grain 229, 230, 237, 243  
 quantum yield 197  
   effect of low phosphorus 64  
*Quercus* spp. 208  
 radiation, solar, *see* solar radiation  
 radiotracers 15  
   metabolic pool 34  
   nitrogen 89  
 rain, acid 207, 209  
 rape, oilseed (*Brassica napus*) 41, 42, 134,  
   138, 140  
 ray cells 221  
 redox potential 135–6, 146  
 reducing capacity, root 135  
 reductants 14, 16  
 reduction, chemical elements for 4  
 reductive pentose phosphate pathway  
   (RRP) 55, 59–60, 65, 68–9  
 regeneration, forest 210–11  
 relative growth rate, *see* growth rate,  
   relative  
 reproduction 180, 183  
 reproductive success 177–8, 179, 180–7  
 resource capture 21–2  
 respiration 10, 234  
   and nitrate reduction 88  
 response surface 190  
 Restionaceae 83  
 RGR, *see* growth rate, relative  
*Rhizobium* 144, 145  
 rhizomorphs 145  
 rhizoplane 128, 133, 134, 136  
   microorganisms 142  
 rhizosphere  
   gradients in 127–31  
   microorganisms 125, 142–6  
   nutrients 125, 127–31; phosphorus 129,  
     145; potassium 129, 130, 131

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)

## Index

281

- pH 126, 127–8, 132–4, 137–8, 143  
 phytosiderophores 138–41  
 root induced changes 132–41  
   *see also* rhizoplane  
 ribose 5-phosphate 67  
 ribulose 5-phosphate kinase 60, 63, 67, 72, 73  
 ribulose biphosphate carboxylase–oxygenase (Rubisco) 11, 72, 86  
   in cereals 232, 233  
   and crop growth rate 11  
   effect of iron stress on 59, 62–3, 73  
   effect of low phosphorus on 65–7, 73  
   nitrogen demand 82  
   and nutrition 21  
   in photosynthesis 21  
   specific activity 233  
   turnover 11  
 ribulose biphosphate (RuBP) 62, 65–7, 69, 72–4  
 ribulose biphosphate (RuBP)  
   concentration in leaves 65–7  
   /triose phosphate ratio 62  
 rice 135  
 ricin 91  
 RNA  
   mRNA 13, 14, 19  
   rRNA 14  
   tRNA 13, 14  
 roots 101  
   aerial 83  
   at localised materials 126  
   *Avena sativa* 34–5  
   capillaroid 83  
   caps 101, 142  
   competition 181  
   dauciform 83  
   development 230  
   extent and efficiency of 7, 104, 168–71, 187–8, 259  
   exudates 101, 106, 125, 127–8, 137–41  
   fibrous 64, 259  
   foraging 178, 258–9, 263  
   genotypic differences 125, 177  
   glutamine synthetase 89, 90  
   grass 138  
   growth 120, 125, 126–7, 234; and  
     infecting microorganisms 145;  
     seasonal 168–71; and temperature  
     107, 168–71  
   hairs 126, 142, 144, 192, 197; length 82,  
     83, 127, 130, 144  
   infections 143  
   and iron 138–9  
   leaf base cluster 83  
   localised nutrient depletion 253  
   and low phosphorus 126  
   metabolism 125  
   mineral gradients along 130–1  
   morphology 127, 131, 143–4, 168, 173,  
     192, 197; and nitrogen acquisition  
     82–3, 192  
   nitrate reductase 133  
   nitrate reduction 86–7, 88  
   nitrogen 10, 192, 259; acquisition 82–3;  
     fixation 84, 85, 88 (*see also* nitrogen,  
     fixation); uptake 192, 232  
   nutrient flux 104  
   of parasitic plants 84  
   phosphatases 141  
   phosphorus 168, 170  
   proteoid 83, 84, 85, 126, 134, 137  
   respiration 127–9  
   /shoot ratio 171, 192, 195; in an  
     ‘extreme’ phenotype 197; and low  
     nutrients 104, 125–7; and mycorrhizal  
     infection 144, 145  
   soil surface 169–71  
   surface area 125, 145  
   surface of, *see* rhizoplane  
   system 82–3, 213, 259, 263; breeding for  
     bigger 197–8; growth relative to shoot  
     101  
   temperature 107, 166, 168–71  
   turnover 106  
 Rothamsted 42, 227  
   Barnfield experiment 40, 41  
   Hoosfield experiment 38  
 RPP (reductive pentose phosphate  
   pathway) 55, 59–60  
 rubidium 3  
 Rubisco, *see* ribulose biphosphate  
   carboxylase–oxygenase  
 RuBP, *see* ribulose biphosphate  
 ruderal species 21, 25, 90  
*Rumex acetosa* 256, 257, 258, 262  
 ryegrass 131  
 salinity 21–2, 159  
   responses to 47, 91  
   tolerance 35–6; by wheat 20  
*Sambucus nigra* 88  
*Sanguisorba minor* 262  
 Saulgau 221  
 savanna flora 84  
*Scabiosa columbaria* 8, 262  
 Scots pine (*Pinus sylvestris*) 208  
 seasonal growth 68–71  
 sedges 83  
 sedoheptulose biphosphatase (SBPase) 65,  
   72, 73  
 seedlings 117, 162, 251, 254

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)282 *Index*

- seeds
  - germination 181
  - production 181, 182–3
- selection 22
- 'selective landscapes' 191
- senescence 39, 232
- shading 113, 117, 120, 181, 188
- shoots
  - architectural rules 187
  - growth rate compared to roots 187–8
  - nitrate reduction in 86–7
  - nitrogen content 115
  - to root ratio, *see under* roots
  - turnover 172
- shrubs 106
- siderophores, *see* phytosiderophores
- Silene nutans* 262
- silicon 3
- silver firs (*Abies alba*) 208
- simulation, *see* models
- sink competition 126
- slopes 165–6, 214
- sodium 3, 8, 36, 47
  - chloride, *see* salinity
  - /potassium ratio 36, 44
  - and protein synthesis 14
- soil 140–1
  - acid 207, 211, 214
  - aeration 81, 127, 128, 132, 135, 143
  - analysis 125, 214
  - bacteria 142–6
  - bicarbonate 136
  - bulk density 127, 128
  - calcareous 8, 129, 132, 135–6, 141, 159–63; manganese toxicity 136; phosphorus deficiency 137–8; phytosiderophores 139; and spruce yellowing 209, 210
  - fertility 159; fast and slow growing species in 173, 197; and forest decline 211–13; and potential growth rate 21; strategies of mineral capture 258–9; *see also* minerals in soils
  - minerals, *see* minerals in soils
  - mycorrhizae, *see* mycorrhizae
  - nitrogen 89, 227–30, 235
  - organic 213, 235
  - pH 132–4
  - phosphates 71, 162; deficiency 137–8
  - physical factors 127, 164–7, 235
  - polder 239
  - saline 8, 129, 159; *see also* salinity
  - silty-loam 129, 140, 239
  - solution 125
  - temperature 164–7, 234
  - water 128, 129, 230, 234, 235, 243; *see also* drought
  - waterlogging 127, 128, 135, 143
  - see also* rhizosphere
- solar radiation 2, 99, 105, 117, 230
  - and closed forests 89–90
  - daylength 107
  - and dry weight gain 106, 107
  - interception 108
  - and temperature of slopes 167
  - transduction by photosynthesis 15
  - see also* light
- Solidago altissima* 110
- solutes
  - pools 34
  - vacuolar 34, 36–7
- sorghum 143
- South America 84
- soybean 19, 63, 67, 69
- space, interactions in 99
- species 251–2
  - coexistence 263
  - dry land 127
  - environmental adaptation within 8
  - growth 2
  - native 158, 167, 171, 199, 249
  - and nutrients 8, 20–2, 158, 162–3, 255–6, 258
  - rare 183
  - slow and fast growing 159, 171–3, 195–7, 253, 259; and nitrogen acquisition 82
- specific absorption rate 171
- Spigelia anthelmia* 88
- spruce, *see* *Picea* spp.
- starch 8, 71, 73, 229
  - /sucrose ratio 69
  - synthesis 56, 68, 242–3
- stele 131
- stems
  - nitrogen 10
  - nodules 85
  - of parasitic plants 84
- Stevenson's screen 166
- stomata 3, 91, 187
  - and carbon dioxide 104
  - conductance in parasites 84
- conifers 221
- strategies
  - alternative to growth 184
  - foraging 178
  - for optimisation of crop characteristics 242–3
  - phenotypic 178, 179, 180, 186
  - plant strategy theory 258–9

## Index

283

- stress 91  
   tolerance 20–1, 157  
*Striga* spp. 85  
 stromal metabolites, phosphate 68  
 sub-top drying 210  
 sucrose 70, 71, 73  
   synthesis 56, 68  
   in vacuoles 37  
 sucrose phosphate phosphatase 68  
 sucrose phosphate synthase 69, 72  
*Sueda maritima* 91  
 sugar  
   in exudates 137, 142  
   in vacuoles 14, 37  
 sugar beet 3, 37, 71–2  
   iron deficiency 56, 57, 62  
   phosphorus deficiency 63, 66, 69, 71–2  
 sugar cane 37–61  
 sugar phosphates 36, 65, 67, 69, 141  
 sulphates 6, 104  
 sulphur 3–6  
 sulphur dioxide 6, 207, 208, 221  
 survival 92, 173, 249  
 symbiosis 84, 185  
 systems analysis 12, 99–100  
  
 ‘take all’ (*Gaeumannomyces graminis*) 143  
 taxa, phenotypes in 179  
 temperate regions 255  
   species in 88, 90  
 temperature  
   air 164–5, 235  
   and development 106–7  
   diurnal 164–7  
   for germination 106  
   and growth 23–5, 105, 106–7, 230, 234, 235  
   and nitrogen mineralisation 82, 83  
   soil 164–7, 234  
 terminal spikelets 115  
 thermal time 107  
 thylakoids 56, 57, 58, 60, 61–2  
 tillers 114  
 time  
   chronological 107  
   interactions in 99  
   plant distribution with 160  
   thermal 107  
 tissue composition 10–11  
   water 39–43  
 ‘tortoise and hare syndrome’ 168  
 totipotent cells 185  
 toxic minerals 19, 250, 256  
 tracers, radioactive, *see* radiotracers  
 transcription 13, 14  
  
 transfer-function 103  
 transketolase 65  
 translocation 13, 14, 19  
 translocators, Fe<sup>III</sup> phytosiderophores 139  
 transpiration 101, 108, 242  
 transport 8  
   of N-compounds 90  
   in parasitic plants 84  
   of phosphorus in chloroplasts 68  
 trees, damage, *see* forests, damage  
*Trema aspera* 88  
*Trisetum flavescens* 258  
*Trifolium* spp.  
   *T. hirtum* 42  
   *T. repens* 168, 182, 258  
   *T. subterraneum* 42  
 triose phosphate 67, 73  
   isomerase 65, 72  
   partitioning 68  
   /PGA ratio 63, 67  
*Triticum aestivum* (wheat)  
   acid phosphatase activity 140  
   aluminium tolerance 19  
   ancient 227  
   bread 229, 242  
   ear yield 183  
   enzymes 17, 18  
   flour 228  
   leucine:tRNA ligase 18  
   mixed culture with lupins 134  
   models 115, 237–42  
   phosphorus deficient 69, 134  
   phytosiderophores 141  
   polyploid genotypes 22  
   potassium concentrations 42  
   protein 228  
   root/shoot ratio 144  
   spring 115, 182–3  
   starch/sucrose ratio 69  
   winter 115, 128, 228, 237–42  
 tropical regions 255  
   species 87, 88, 90  
 tubers, *see* potatoes  
 turgor 37, 39, 40, 44, 45  
  
 UDPG (uridine diphosphate glucose) 68, 70  
 Unit of Comparative Plant Ecology (UCPE) 158, 160–1, 164, 165  
 urbanisation 253  
 ureides 87, 90  
 uridine diphosphate glucose  
   pyrophosphorylase 70, 72  
 uridine diphosphate glucose (UDPG) 68, 70

Cambridge University Press

978-0-521-10365-7 - Plant Growth: Interactions with Nutrition and Environment

Edited by J. R. Porter and D. W. Lawlor

Index

[More information](#)284 *Index**Urtica dioica* 21, 88, 161–3, 261USA, *see* North America

vacuoles 13–14, 36–7

composition 14, 34–5, 36–7

malate in 37

nitrogen in 35, 112

and osmotic balance 37

phosphorus in 16

potassium in 6, 37, 44, 45

vascular tissue 218–19, 221

vegetation 253

*Verbascum thapsus* 183

vernalisation 235

vesicular–arbuscular mycorrhizae (VAM)

145, 262

*Vicia* spp.*V. faba* 41, 42*V. sativa* 42*Vigna sinensis* 56

vine forests 85

Wales, North, white clover growth 168

water 1, 101, 105, 117, 227, 230

competition for 99

loss 90, 101, 104, 108, 187

nutrient concentrations in tissue water  
39–43

soil: and nutrient uptake 128, 129;

uptake 131

splitting 5, 6, 56

stress 2, 91; *see also* drought

use efficiency 104

waterlogging 127, 128, 135, 143

wavy hair grass (*Deschampsia flexuosa*) 21,  
159–63, 186, 195

weather, and growth 227

weathering, of minerals 129

weed control 250

wheat, *see* *Triticum aestivum*

Whiteface Mountain 211, 212

winter growth 168, 171

wood production 217, 219

woody plants 20, 83, 87, 90

xanthophyll 56, 58

X-ray microanalysis 36, 45, 46, 47–8

xylem 218–19

ammonium in 86

root 131

yellowing 136, 139, 209, 210–11, 216,  
220

yield

dry weight 108

grain 227, 229–30, 237–9, 241–2, 243

nitrogen 239, 242

responses 158–65, 183, 242

*Zea mays* (maize) 104, 130, 143

calcium deficiency 161

effect of soil bulk density 127

elemental composition 9

and iron deficiency 19

phosphorus deficiency 126

zinc 6, 8, 138, 145

concentrations 5

deficiency 134, 137, 141

enhanced uptake 132, 138

in spruce needles 215

transport in mucilage 137