

CONTENTS

Contributors	xi
Preface	xv
1 <i>Arabidopsis</i> Root Development	1
<i>Marijn Luijten and Renze Heidstra</i>	
1.1 Introduction	1
1.2 Specification of the apical and basal cell lineage	3
1.3 Root stem cell niche specification	10
1.4 Radial patterning	14
1.5 Stem cell maintenance	18
1.6 Meristem maintenance and root zonation	22
1.7 Meristem activation, root growth and cell division	25
1.8 Concluding remarks	28
2 Vascular Morphogenesis During Root Development	39
<i>Ana Campilho, Ove Lindgren and Ykä Helariutta</i>	
2.1 Introduction	39
2.2 The <i>Arabidopsis</i> root vascular system	40
2.3 Molecular genetics of the stele: a rapidly developing field	44
2.4 Vascular genomics – getting the big picture	57
3 Root Epidermal Development in <i>Arabidopsis</i>	64
<i>Rebecca Horn, Keke Yi, Benoît Menand, Monica Pernas-Ochoa, Seiji Takeda, Tom Walker and Liam Dolan</i>	
3.1 Introduction	65
3.2 Establishment of the epidermis in <i>Arabidopsis</i>	65
3.3 Establishment of distinct cell fates in the root epidermis	68
3.4 Root hair initiation and tip growth	70
3.5 Effects of nutrients on root hair cell differentiation and morphogenesis	75
3.6 Root hairs and nutrient uptake	76
3.7 Perspectives	77

4	Lateral Root Formation	83
	<i>Jocelyn E. Malamy</i>	
4.1	Introduction	83
4.2	How does a single lateral root form?	85
4.3	How are the number and placement of lateral roots determined?	107
4.4	Agricultural importance of lateral root formation	112
5	Adventitious Root Formation: New Insights and Perspectives	127
	<i>Gaia Geiss, Laurent Gutierrez and Catherine Bellini</i>	
5.1	Introduction	128
5.2	Role and origin of ARs	128
5.3	Factors influencing adventitious rooting	131
5.4	New insights into genetics and molecular mechanisms involved in adventitious rooting	142
5.5	Conclusion and perspectives	147
6	Root Gravitropism	157
	<i>Ranjan Swarup and Malcolm J. Bennett</i>	
6.1	Introduction	157
6.2	Gravity perception	158
6.3	Root gravitropic signal transmission	160
6.4	The root gravitropic response	164
6.5	Attenuating the root gravitropic response	166
6.6	Future directions	167
7	Molecular and Genetic Dissection of Cereal Root System Development	175
	<i>Frank Hochholdinger and Roman Zimmermann</i>	
7.1	Introduction	175
7.2	Morphology of cereal root systems	176
7.3	Morphological and anatomical comparison of <i>Arabidopsis</i> and cereal root systems	177
7.4	Molecular and genetic analysis of cereal root formation	178
7.5	Prospects	187
8	Fern Root Development	192
	<i>Guichuan Hou and Alison B. Blancaflor</i>	
8.1	Introduction	192
8.2	Overview of the fern root system – shoot-borne roots	195
8.3	Anatomical and structural aspects of fern root development	197

8.4	LR formation in ferns	203
8.5	Concluding remarks and future prospects	205
9	When Plants Socialize: Symbioses and Root Development <i>Benjamin P��ret, Sergio Svistoonoff and Laurent Laplaze</i>	209
9.1	Introduction	209
9.2	Arbuscular mycorrhizae	210
9.3	Ectomycorrhizae	218
9.4	Actinorhizal symbioses	223
9.5	Concluding remarks	228
10	Legume Root Architecture: A Peculiar Root System <i>Silvina Gonzalez-Rizzo, Philippe Laporte, Martin Crespi and Florian Frugier</i>	239
10.1	Comparison of legume lateral roots and nitrogen-fixing nodules	240
10.2	Recent advances in genetics and genomics of nitrogen-fixing nodule development in legumes	245
10.3	Evidences for a crosstalk between symbiotic nodule and LR developmental pathways	257
10.4	Common signals in nodulation and LR development	263
11	Effect of Nutrient Availability on Root System Development <i>Alfredo Cruz-Ram��rez, Carlos Calder��n-V��zquez and Luis Herrera-Estrella</i>	288
11.1	Introduction	288
11.2	Regulation of the root system architecture by nutrient availability	292
11.3	Conclusions	315
12	Studying Root Development Using a Genomic Approach <i>Jose R. Dinneny and Philip N. Benfey</i>	325
12.1	Introduction: how root development enables a genomic approach	326
12.2	Genome-scale technologies for understanding gene function	327
12.3	Building transcriptional networks: an introduction	330
12.4	Building transcriptional networks I: creating high-resolution spatial maps of gene expression	331
12.5	Building transcriptional networks II: exploring the role of transcriptional and posttranscriptional mechanisms in regulating TF activity	339
12.6	Building transcriptional networks III: identifying direct targets of TFS – the SHORTROOT pathway	341

12.7	Exploring gene function using genomic variation: quantitative trait locus analysis of root growth	343
12.8	Future directions: from single gene biology to systems biology	345
Index		352
Color plate (between pages 174 and 175)		