

2704-123 3

# Plant Roots

## The Hidden Half

edited by

Yoav Waisel  
Amram Eshel

*Tel Aviv University  
Tel Aviv, Israel*

Uzi Kafkafi

*Hebrew University of Jerusalem  
Rehovot, Israel*

Marcel Dekker, Inc.

New York • Basel • Hong Kong

# Contents

<i>Preface</i>	<i>iii</i>
<i>Contributors</i>	<i>xi</i>
I THE ROOT SYSTEM: STRUCTURE AND DEVELOPMENT	
1 CHARACTERISTICS AND FUNCTIONS OF ROOT SYSTEMS A. H. Fitter	3
2 GENETIC CONTROL OF ROOT SYSTEMS Richard W. Zobel	25
3 MULTIFORM BEHAVIOR OF VARIOUS CONSTITUENTS OF ONE ROOT SYSTEM Yoav Waisel and Amram Eshel	39
4 ROOT CAP: STRUCTURE AND FUNCTION Andreas Sievers and W. Hensel	53
5 THE ROOT APICAL MERISTEM AND ITS MARGINS Ronald D. MacLeod	75
6 LATERAL ROOT INITIATION W. A. Charlton	103
7 ROOT HAIRS Rose-Marie Hofer	129
8 CAMBIAL ACTIVITY OF ROOTS Frank W. Woods	149
II GROWTH AND METABOLISM	
9 SYNTHESIS OF PLANT GROWTH REGULATORS BY ROOTS Chanan Itai and Helen Birnbaum	163

10	ROOT GROWTH AND GRAVIREACTION: IMPLICATIONS OF HORMONES AND OTHER REGULATORS Paul-Emile Pilet	179
11	CALCIUM AND ROOT DEVELOPMENT: IMPORTANCE OF CALCIUM IN SIGNAL TRANSDUCTION B. W. Poovaiah and A. S. N. Reddy	205
12	RESPIRATORY PATTERNS IN ROOTS IN RELATION TO THEIR FUNCTIONING Hans Lambers, Adrie van der Werf, and Henk Konings	229
13	ROOT-SHOOT RELATIONSHIPS Betty Klepper	265
14	TREE ROOT TURNOVER AND SENESCENCE Kristiina A. Vogt and Janine Bloomfield	287
III GROWTH UNDER STRESS		
15	SOIL TEMPERATURE, ROOT GROWTH, AND PLANT FUNCTION Glynn D. Bowen	309
16	GROWTH UNDER OXYGEN STRESS Malcolm C. Drew and Lewis H. Stolzy	331
17	GROWTH UNDER STRESS: HEAVY METALS S.-W. Breckle	351
18	ROOT GROWTH UNDER STRESS: SALINITY Uzi Kafkafi	375
19	GROWTH AND MECHANICAL IMPEDANCE Alan T. P. Bennie	393
IV ION AND WATER TRANSPORT		
20	ROOT STRUCTURE AND SITES OF ION UPTAKE David T. Clarkson	417
21	DYNAMICS OF NUTRIENT MOVEMENT AT THE SOIL-ROOT INTERFACE Albrecht O. Jungk	455
22	UPTAKE MECHANISMS Per Nissen	483
23	ROOT-INDUCED CHANGES IN THE AVAILABILITY OF MICRONUTRIENTS IN THE RHIZOSPHERE Horst Marschner	503
24	ROOT EXCRETIONS AND THEIR ENVIRONMENTAL EFFECTS: INFLUENCE ON AVAILABILITY OF PHOSPHORUS B. Bar-Yosef	529
25	TRANSPORT OF WATER IN THE RHIZOSPHERE AND IN ROOTS J. J. Oertli	559
26	ROOT PRESSURE Vladimir Zholkevich	589

Contents	ix
27 DYNAMICS OF WATER PERMEABILITY Samuel Moreshet and Morris G. Huck	605
28 CARBON UPTAKE BY ROOTS Andrew M. Farmer and Michael S. Adams	627
V THE RHIZOSPHERE	
29 THE RHIZOSPHERE: THE HIDDEN HALF OF THE HIDDEN HALF Glynn D. Bowen and Albert D. Rovira	641
30 ROOT-BACTERIA INTERACTIONS: SYMBIOTIC NITROGEN FIXATION Carroll P. Vance	671
31 NONSYMBIOTIC NITROGEN-FIXING MICROORGANISMS Yoram Kapulnik	703
32 PLANT-GROWTH-PROMOTING RHIZOBACTERIA Yoram Kapulnik	717
33 MYCORRHIZAE Hugh E. Wilcox	731
34 MYCORRHIZAE IN AGRICULTURAL CROPS James Krikun	767
VI ROOT PESTS	
35 ROOT-NEMATODE INTERACTIONS Eli Cohn and Yitzhak Spiegel	789
36 ARTHROPOD ROOT PESTS Uri Gerson	807
37 INTERACTIONS OF ROOTS WITH SOIL-BORNE PATHOGENS J. Katan	823
VII ROOTS OF VARIOUS ECOLOGICAL GROUPS OF PLANTS	
38 ECOPHYSIOLOGY OF ROOTS OF DESERT PLANTS, WITH SPECIAL EMPHASIS ON AGAVES AND CACTI Park S. Nobel	839
39 AERIAL ROOTS AND THEIR ENVIRONMENTS David H. Benzing	867
40 ECOPHYSIOLOGY OF ROOTS OF SUBMERGED AQUATIC PLANTS Yoav Waisel and Moshe Agami	887
<i>Index of Common and Scientific Names</i>	907
<i>Subject Index</i>	921