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Volumes are organized topically and provide a comprehensive discussion of developments in the field over the past 3–5 years. The series also discusses new discoveries and applications. Special volumes are dedicated to selected topics which focus on new biotechnological products and new processes for their synthesis and purification.

In general, volumes are edited by well-known guest editors. The series editor and publisher will, however, always be pleased to receive suggestions and supplementary information. Manuscripts are accepted in English.

In references, *Advances in Biochemical Engineering/Biotechnology* is abbreviated as *Adv. Biochem. Engin./Biotechnol.* and cited as a journal.

Pauline M. Doran
Editor

Biotechnology of Hairy Root Systems

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ISSN 0724-6145 ISSN 1616-8542 (electronic)
ISBN 978-3-642-39018-0 ISBN 978-3-642-39019-7 (eBook)
DOI 10.1007/978-3-642-39019-7
Springer Heidelberg New York Dordrecht London

Library of Congress Control Number: 2013943946

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Printed on acid-free paper

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Preface

Hairy roots were studied in the 1930s–1960s as an indicator of pathogen attack in horticultural plants such as apple trees and roses. The responsible bacterial agent, *Agrobacterium rhizogenes*, was identified and the role of gene transfer from the bacterial Ri (root-inducing) plasmid was revealed in the 1970s and 1980s. Starting in the mid-1980s, it was recognised that hairy roots cultured in vitro could be used as a tool in studies of secondary metabolism and, ultimately, as production systems for natural products. This led to a burst of research activity in these areas, focusing on the intrinsic benefits of root organ differentiation for secondary pathway activity. This research is ongoing today. In the meantime, a greater and more detailed understanding of the molecular biology of bacteria–plant infection emerged, supporting an expansion in the range of applications of hairy roots in biology, biotechnology and engineering. Hairy roots became a convenient and reliable tool for many laboratory-based studies.

In 1997, a research monograph, *Hairy Roots: Culture and Applications* (P. M. Doran, Harwood Academic) provided a snapshot of the state of research activity in hairy root biotechnology at that time. In 21 chapters, the laboratory protocols for initiation, culture and genetic transformation of hairy roots were set out, applications in alkaloid synthesis and plant propagation were described, and bioprocessing considerations for large-scale hairy root culture were outlined. Early work on the expression of foreign proteins and metal uptake using hairy roots was also represented. This volume reflected a broad cross-disciplinary interest in hairy roots, involving scientists in many areas ranging from genetics and molecular biology to horticulture, medicine, environmental studies and bioprocess engineering.

Today, the exploitation of hairy roots in biotechnology and bioprocessing research continues, with over 100 papers published each year on the topic. This special issue provides an update in those areas where our knowledge on hairy roots and the development of their applications have advanced significantly in recent times. The complex effects that agrobacterial genes have on plant cells, such as perturbation of stress responses and defence strategies, are now recognised as important mechanisms of pathogenicity in infected plants. Increasing interest in secondary pathway elucidation and the use of metabolic engineering principles to improve pathway function has led to an expanded role for hairy roots in this

context. Further progress to elicit and enhance secondary metabolite production in bioprocessing systems has been made. New products synthesised using hairy roots, such as metallo-organic nanocrystals and foreign proteins for vaccine synthesis, are also highlighted in this volume as an encouragement for further work in these areas.

I would like to thank all the authors who have contributed chapters to this special issue for their readiness to be involved, their expertise, and their efforts in creating comprehensive review papers. I am also grateful to Thomas Scheper and Springer for their friendly collegiality and support of this project.

Pauline M. Doran

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