



BOOK REVIEW

Hairy roots, culture and application, edited by PAULINE M. DORAN, Gordon and Breach, Reading, 256 pp. £62. ISBN 90-570-117-X.

This wide-ranging and informative book on hairy root biotechnology is extremely readable for non-specialists. There is a strong international representation of considered experts in the field from both academia, governmental research institutions and industry. Hairy roots have only recently been widely used as a model plant system so it is not terribly surprising to discover that several researchers do not appreciate significant differences between hairy and normal root cultures. Hairy roots are, in fact, *Agrobacterium rhizogenes*-transformed roots, with an ability to be maintained indefinitely *in vitro* on hormone-free media and with the potentiality to produce secondary metabolites at levels similar to intact plants. Strenuous efforts have also been made to ensure that the reader is not drowning in technical slang. This, alone, is admirable!

Hairy roots confer substantial advantages over cell cultures because hairy root cultures retain histological features of the tissue *in vivo* and preserve *in vivo* architecture. Cell cultures, however, have lost their 3-dimensional tissue architecture and many of the biochemical properties associated with it. Cell cultures also tend to be less genetically and biochemically stable, often experiencing somaclonal variation. The book also provides an honest account of the limitations of hairy root cultures. One limitation repeatedly quoted is that hairy roots may not produce secondary compounds which are made in the aerial parts of the intact plant. Not surprisingly, shoot cultures are also largely restricted to producing substances wholly synthesised in the leaves of the parent plant.

The book reviews relatively broad subject areas where hairy roots do play an important role advancing our knowledge of plant science. This book is subdivided into three main parts; “hairy root culture and product synthesis”, “plant propagation and environmental aspects of hairy roots” and “bioprocessing aspects of hairy roots”. The first part discusses their use in studying secondary metabolic pathways and as expression systems for antibody production. The chapters provide practical information for researchers. In particular, chapter one is particularly illuminating with detailed laboratory practical schedules for establishing hairy root cultures and introducing foreign genes into these root cultures. Organ-specific enzymes in the roots may produce a metabolic

precursor which is translocated to the aerial parts of the plant for conversion to another product. If these organ-specific properties are retained, neither root or shoot cultures alone will be successful for appropriate product synthesis. Innovative root-shoot co-cultures for secondary metabolite production, requiring both roots and shoots, are explored. The second part of the book provides an up-to-date account of the use of *A. rhizogenes* as a gene delivery system and as a vector for plant transformation and subsequent regeneration into transgenic plants. Further applications of hairy root cultures in studying host/parasite interactions and for potential screening of agrochemicals for fungicides, nematocides and herbicides are examined. As roots are the primary contact between the plant and soil xenobiotics, hairy roots may also play a role in phytoremediation by accumulation of environmental pollutants such as heavy metals. This book is also of particular interest to biochemical engineers and industrial scientists requiring information on the hydrodynamic behaviour of hairy roots for secondary metabolite production in large-scale bio-reactors. The particular morphology of transformed root cultures has an obvious impact on reactor design and operation. Fungal elicitors have also been used to stimulate secondary metabolite production in large-scale bio-reactors. Most secondary metabolites are sequestered in intracellular compartments of the plant cell. Innovative two phase systems coupled to *in situ* extraction are explored for ultimate commercial exploitation of secondary metabolites by hairy root cultures.

Emphasis has been placed on the application and exploitation of hairy roots which would ensure that this book should become invaluable and integral reference material for undergraduate and postgraduate plant biotechnology courses as well as being an indispensable research manual for those investigators gravitating towards hairy root cultures. Many plant scientists happily work within the confines of their model plant system. This book provides a powerful case for many investigators to consider working with organised and stable transformed roots. Hairy roots offer an intermediate physiological step between the intact plant and callus/suspension culture for those researchers, in particular, who currently work exclusively with cell cultures and are considering a model system that closely resembles intact plant tissue *in vivo*. Hairy roots have obvious clear, defined advantages over many other model systems for commercial exploitation and sustained pure research inves-

tigations. The book is well-presented and lavishly illustrated with a preponderance of high quality photographs and figures. A broad-based book devoted to hairy root biotechnology and appealing to a wide audience will inevitably help to raise the profile

of hairy roots as a versatile and physiologically-relevant plant model.

School of Applied Science, Mike Brownleader
South Bank University, London, U.K