BOOK REVIEW

BIOLOGICAL NITROGEN FIXATION IN FOREST ECOSYSTEMS: FOUNDATIONS AND APPLICATIONS

Edited by J. C. Gordon and C. T. Wheeler
Martinus Nijhoff/Dr W. Junk, The Hague. 1983.
342 pages. ISBN 90-247-2849-5. US$65.50.

As the introductory chapter states, this book is intended for use by foresters and land managers wishing to use and understand biological nitrogen fixation, and to allow the researcher or practitioner only marginally familiar with the processes and applications of nitrogen fixation to gain access to its potential as a management tool. The book is therefore aimed at a wide audience. The content, however, is weighted more strongly towards the foundations than to the applications of nitrogen fixation, and it will be researchers and students who will find the book of greatest use.

The classification of nitrogen-fixing organisms and the morphology and some aspects of the physiology of free-living and symbiotic nitrogen-fixers, is followed by a most useful chapter on the taxonomy and distribution of non-legume nitrogen-fixing systems. This chapter deals mainly with plants bearing *Alnus*-type nodules as the author considers that these associations offer the best prospects for exploitation amongst non-legumes. The book does not contain an account of the taxonomy and distribution of leguminous systems, but a later chapter gives references to recent texts on this subject. About half of a chapter on the biochemical and physiological aspects of symbiotic nitrogen-fixation is devoted to a discussion on the manner in which environmental factors influence nodulation and symbiotic nitrogen-fixation.

Two chapters deal with techniques. "Isolation and culture of nitrogen fixing organisms" describes the isolation and culture of *Frankia* in detail and, because of abundant literature already published, describes the isolation of *Rhizobium* only briefly. This is very much a chapter of recipes. "Analysis of nitrogen fixation" is much broader in scope. Qualitative methods that indicate nitrogen-fixing species or sites are described, and direct and indirect methods of nitrogen-fixation assessment are outlined. General principles, methodology, limitations, and application of these techniques are discussed.

A range of topics is covered in the chapter, "Agricultural and horticultural systems: Implications for forestry" but none are dealt with in great depth. In this I would have expected to see some discussion on the influence of grazing animals on nitrogen cycling. Grazing is mentioned in a section entitled "Defoliation in relation to nitrogen release", but only in a detrimental sense, and not in relation to nitrogen cycling. The use of nitrogen-fixing trees, shrubs, and herbs in plantation forestry is reviewed and criteria are established to screen nitrogen-fixing plants for use in pine plantations. This chapter includes a discussion on economics. The authors conclude that, although there

is ample evidence of the benefits of biologically fixed nitrogen in plantation forestry through improvements in wood volume growth, economic analyses show that additional growth can be achieved more cheaply through inorganic nitrogen fertilisation. However, the possibility of using grazing animals in plantations with a legume understorey is not considered.

The final four chapters review research and practice of biological nitrogen-fixation in forests in North America, Europe, South-east Asia, and Australia and New Zealand. In three of the four regions, there has been a substantial amount of research into nitrogen fixation in natural and managed forests, but symbiotic nitrogen-fixing systems have rarely been employed as silvicultural tools on a large scale. By contrast, in the fourth region, South-east Asia, research into symbiotic nitrogen-fixation is only just beginning, but the authors provide a number of examples where nitrogen-fixing systems are actively used in forestry.

Some of the chapters in the book would have benefited by further editing and there is some overlap between authors in the material covered. These are minor problems, however, and the appearance of this book is timely in relation to changes which are occurring in New Zealand forestry at present. With the trend towards wider spacing and earlier thinning and pruning in *Pinus radiata* plantations, and the current interest in agroforestry, interest in biological nitrogen fixation in forests is likely to increase substantially in the future.

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