Forest Vegetation Management: Developments in the Science and Practice

Introduction

The practices of forest vegetation management (FVM) have been widely adopted and continue to undergo country-specific modifications through extensive research. Beginnings of this component discipline of silviculture were in weed science in the 1960s and focused primarily on translating developing herbicide technology underway in agriculture to forestry uses. It was an attempt to replace and supplement manual and mechanical treatment methods for forest stand establishment. More recently, FVM has become synonymous with integrated vegetation management as multiple treatments have been combined in many countries to enhance forest productivity, health and eco-services. Concerted research and development over the past 40 years has yielded options involving combinations of modern herbicides and mechanical, fire, cultural, biological and manual treatments.

The primary objective of FMV remains to enhance wood yields while other objectives are being developed, such as the management and restoration of special habitats, recreational and historical landscapes, and invasive plant infestations. Owing to these rapid developments, coupled with the counter world-wide trend to restrict forest herbicide use, further efforts are needed to summarize and synthesize FVM research in support of knowledgeable choices and decisions. This Special Issue is a contribution to this effort.

A main topic session dedicated to FVM was held for the first time at the Fourth International Weed Science Congress, June 2004, in Durban, South Africa. This International Congress is convened every 3–4 years by the International Weed Science Society; this conference was co-hosted by the South African Weed Science Society. This first FVM session, together with the global-scale plenary and 26 other main topic sessions of the Congress, provided scientists with the most current context of present and potential systems for food and fibre production, as well as the challenges facing their sustainability.

This inaugural FVM session had 32 delegates from 12 countries and consisted of five invited synthesis reports, 10 offered oral papers, and nine posters. A well-attended 5-day post-congress tour, organized by our in-country host, Dr Keith M. Little, Institute for Commercial Forestry Research, afforded extended discussions of FVM practices underway on several continents as we toured some of the most intensively managed forest plantations in the world.

This special issue of *Forestry* presents a selection of four papers from the session, while others will be published at later dates. The four papers focus on three areas long recognized as needing synthesis and one detailing a conceptual development. The reviews address: a summarization of research on competition–crop interactions to yield general principles for FVM, the potential wood gains from FVM, and the latest developments in growth-response modelling and decision support systems that incorporate FVM. The concept paper reports validation and sensitivity tests on a recently formulated metric for expressing growth response from FVM. An objective of all four papers was to provide timely reviews that yield useful concepts and technology for

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researchers, as well as forest management practitioners and policy makers.

The first paper is a review and synthesis by Philippe Balandier and co-authors, 'Designing forest vegetation management strategies based on the mechanisms and dynamics of crop tree competition by neighbouring vegetation'. The authors summarize 162 cited reports that document crop tree response, and competition relationships and their mechanisms. The synthesis organizes competitive dynamics according to growth forms of competitors in a simplification that yields clarity to complex interactions. The approach is skilfully used to delve the interplay among crop trees and competitors during sequences of stand development and FVM treatments. The physiological and micro-environmental mechanisms that characterize competitive interactions are summarized and then distilled into sections on 'Principles of Sustainable FVM' and on research needs. A persistent and valid criticism has been made that much FVM research involves repeated experiments on competition control and short-term crop tree response without gaining general principles and understandings of mechanisms that would consistently guide management and foster the next level of research. This synthesis makes significant strides towards providing these general principles guided by a thorough review.

A crucial synthesis report for these times is authored by Robert G. Wagner and co-authors, 'The role of vegetation management for enhancing productivity of the world's forests'. This invaluable synthesis provides new insights into what production gains are at stake as the world-wide debate on the continued uses of forestry herbicides intensifies. The focus of the report is the 60 longest-term studies from four continents and New Zealand that document wood volume gained from FVM. This summary provides timely evidence that early control of woody and herbaceous competition, if applied correctly, consistently results in more wood and fibre required from the shrinking forest areas of the world. This large number of studies has reached ample maturity only recently to yield reliable data to warrant this summary.

A vital overview paper is presented by Brian Richardson and co-authors (all from New Zealand), 'Advances in modelling and decision support systems for forest vegetation management in young forest plantations'. These authors have been active members of a long-term team in New Zealand who are pushing the forefront of developments in growth models and decision support systems incorporating FVM responses. Details are shared on the conceptual, mathematical and field research undertaken toward constructing realistic modelling tools for practitioners. Other countries and locales can benefit from knowing the data requirements, equations used and lessons learned in New Zealand. In order to make the models most useful for practitioners, the team has led the world in incorporating FVM models into state-of-the-science decision support systems. Valuable insights are given on the challenges they have faced in transferring this technology to users and possible ways to be more efficient in this.

Another effort to advance FVM models for economic analyses is provided by David B. South and co-authors, "Determining productivity gains from herbaceous vegetation management with 'age-shift' calculations". This paper examines the long-recognized problem in FVM research of how to realistically express crop tree growth gains in a usable metric that results from vegetation control treatments. Also reported is how expressions using 'percentage gains' compare with those using the more recently proposed 'age-shift'. These authors use the multi-site, long-term study in the southern US to make comparisons between percentage gains and age-shift and to test the sensitivity of age-shift calculations. They conclude that "age-shift" has several advantages that warrant wider use in growth-gain expressions and identify limitations. A valuable tutorial is provided on the five methods currently available for calculating age-shift and the data and model requirements.

FVM has been largely focused on early plantation establishment, but now that plantation technologies are in place and long-term data are accumulating, this discipline continues to explore later stand, mixed stand and uneven-aged stand establishment and management. The contributions in this Special Issue should form foundations for future advancements.

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