Introduction

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This Special Issue of the *International Journal of Biotechnology* contains a set of papers related to the use of Biotechnology in Forestry. The main objective is to provide a collection of works in order to answer some of the main questions related to the

application, technology development and social benefits, management and public perception of Forest Biotechnology.

Although Forestry Research in Biotechnology has changed deeply in the last 15 years, the experience with biotechnology in trees is still limited. Forest biotechnology research includes:

- characterisation of genetic diversity
- mapping, markers-assisted selection and genomics
- micropropagation and
- genetic modification.

A genetically modified tree that involves the alteration of the genome by the insertion of genes using a non-sexual approach is considered to be a bioengineered tree and it is defined as transgenic. Genetic modification of trees is a highly controversial issue and there is not a general consensus about its potential benefits and risks. Field trials of genetically modified trees exist in a relative large number of countries; however; only China has reported the commercial release of GM trees (Food and Agricultural Organization, 2004).

The current importance of biotechnology in forestry can be found in the fact that intensively managed planted forests, which have substantially higher biological yields, are becoming an important source of timber and have the potential to dominate industrial wood production (Sedjo and Botkin, 1997). In addition, it is estimated that roughly one-third of today's timber comes from planted forests, compared to an insignificant portion 50 years ago (Food and Agriculture Organization, 2001).

The dominant themes of the papers presented in this issue can be classified into three main areas: technology development and applications, forestry management and public perception of biotechnology in forestry.

Technology developments and applications: technology developments and applications are the processes governing the utilisation of innovations in the forestry sector. The applications of biotechnology to trees, the traits and trials for genetically engineered trees and possible uses for environmental, social benefits and biosafety are presented in the paper by Kellison, Balocchi, Valenzuela and Rodríguez. Accepting the fact that in the future trees will be developed with specific characteristics to fit environmental, social and economic needs, this work presents a programme that would allow forest biotechnology to address many of these questions at the beginning of the technology development, incorporating research directed to social benefits and engaging a wide audience to insure the best possible outcomes. The paper by Kellison and McCord is based on the idea that balancing the growing demand for forest products against the need for forest protection will be increasingly difficult over the next 50 years and that trees to be developed in the future will inevitably include specific characteristics to fit environmental, social and economic world needs. According to the authors, the importance of the species that might warrant development of a transgenic tree should be related to the recovery of the species from near extension. Fast-growing commercial species with a short rotation to financial maturity, such as the American chestnut, could be on the horizon.

Forestry management and biotechnology: few attempts have been made in the literature to assess the effects of biotechnology in the management of forests. The

adoption and diffusion of innovations can be understood as the rational response of producers to the existing benefit expectations.[1]

The paper by Xabadia aims to quantify the potential benefits of biotechnology under a selective-logging regime. With this purpose, an empirical analysis is conducted to determine the optimal selective-logging management for a stand of *Pinus Sylvestris* and then is compared with the outcome generated when biotechnology is employed to accelerate forest growth. The empirical analysis shows how the optimal management of forest changes when new breeding techniques are utilised, resulting in more pronounced cyclical behaviour of the variables from the very beginning and throughout the planning horizon. Moreover, the acceleration of forest growth driven by the introduction of new breeding techniques increases the structural diversity in the long-run.

The economic value of biotechnology to improve growth and wood properties of trees is addressed by Peter, White, De La Torre, Singh and Newman using a multidimensional cash flow modelling of a loblolly pine plantation and an integrated kraft pulp and paper mill. The results show that genetically improved trees with faster growth and better wood properties can in some cases dramatically increase mill profitability. All of the traits modelled increased linerboard mill profitability, with the greatest increase estimated for higher fibre tensile strength followed by increased specific gravity, growth and increased cellulose-to-lignin ratio.

Public perceptions of biotechnology in forestry: the relevance of public perceptions of biotechnology in forestry is well set out in the paper by Hall and in the paper by Neumann, Krogman and Thomas. The contribution of the paper by Hall is a consideration of a range of issues, such as technological applications, public concerns and the role of protest groups, in order to examine the similarities and differences between the food debate on the use of genetically modified food and the genetically modified debate in forestry. The main conclusion is that commercialisation of GM trees is likely to be as problematic as the commercialisation of GM crops. Hence, it is recommended that public concerns that attempt to value the wider potential costs and benefits of forestry biotechnology should have to be investigated and protest groups should have to be listened to.

Public perception of Biotechnology for Hybrid Poplar Plantations is the subject of the paper by Neumann, Krogman and Thomas. This paper describes the differences between expert and public perceptions of plantation forestry and calls for greater public participation in the development and establishment of plantations. In this paper, the discussion over the social acceptability of varying land-uses is considered to be essentially a debate over how land is valued and the effects of land-use change on local peoples. The study reports the findings from 31 interviews with key informants, indicating some central themes which are important to the forestry sector such as farming identity, trust and economic competition.

To conclude, a number of measures that could improve the articulation of the biotechnology innovation system in forestry have been discussed in this Special Issue. An important point is the consideration of inefficiencies in the private and public use decisions and the significance of social and institutional factors in the design of forest regulations that could reduce some problems related to biotechnological innovation. At the end, the relevance of public policies is linked to make technology adoption easier, not only from the silvicultural point of view, but also from a wider social perspective.

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Note

[1]This is the main conclusion of the seminal papers by Griliches on the diffusion of hybrid corn, (Griliches, 1957) and Mansfield on the industrial sector (Mansfield, 1961).