

Module 7: MAS in Tree Improvement – Concepts and Experimental Results Outline

Introduction

The purpose of Module 7 is to build upon the approaches of QTL and Association genetic mapping (Modules 5 & 6) as tools for Marker Assisted Selection (MAS) and Marked Assisted Breeding (MAB). Alternative approaches to MAS are introduced, their advantages and disadvantages discussed, and results of case studies in forest trees investigated. This module completes the foundation needed to discuss implementation strategies for MAS and other marker applications in forest tree improvement programs (Module 8) and natural resource management and ecosystem health (Module 9).

Key Messages

- Marker assisted selection and breeding are conceptually compelling yet applications in crop and forest tree species are few.
- The allure to MAS in forestry is driven by the prospects of significantly reducing generation times, decreasing field test costs, or increasing genetic gain per unit of effort.
- Alternative approaches to MAS (LE, LD, Gene) are differentiated by the proximity of the marker polymorphism to the functional mutation.
- Experimental results with forest trees show promise for MAS but commercial application will require appropriate populations, large-scale gene and SNP discovery, high throughput phenotyping and novel analytical approaches.

Outcomes

Course attendees will:

- Gain an understanding of the goals and objectives of MAS, the allure of the technology for forest tree species, and the current status of application in industry.
- Learn to differentiate between alternative approaches to MAS, what is required to apply each approach, and the potential utility of each.
- Acquire the guidelines for expanding the current body of knowledge on MAS in forest trees to include all known genes and how to associate polymorphisms with phenotypic variation.

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Outline

- I) Introduction to MAS
 - A) *Goals and Objectives*
 - B) *Allure of MAS*
 - C) *Current Status*

- II) Alternative Approaches to MAS
 - A) *LE MAS, LD MAS, GENE MAS*
 - B) *MAS and the Tree Improvement Process*
 - C) *Traits Suited to MAS*

- III) LE MAS
 - A) *QTL Mapping – Concept*
 - B) *Experimental Case Study: Loblolly Pine Wood Properties*
 - C) *Take Home Lessons*
 - D) *Applied Case Study: CAD null allele*
 - 1) *Limitations of LE MAS*

- IV) LD MAS / GENE MAS
 - A) *Association Genetics*
 - B) *Experimental Case Study: Loblolly pine Wood Properties*
 - C) *Association Genetics Components*
 - 1) *Populations*
 - 2) *Nucleotide Diversity / Neutrality Tests*
 - 3) *LD*
 - 4) *Associations*
 - D) *Experimental Case Study: Douglas-fir Adaptation Traits*

- V) Review