

## **Module 8: Implementation Strategies and Economics of MAS in Tree Improvement**

### **Introduction**

The primary purpose of Module 8 is to demonstrate implementation strategies for MAS in tree improvement by building upon information developed in the previous modules (with emphasis on Modules 2 and 6). Additionally, alternative applications of genetic markers for managing genetic variation in breeding programs are described or illustrated. The module concludes with an economic analysis of MAS applications based on modeled gains and simulated econometric models for probabilistic forecasting and risk analysis (Simetar) developed for agricultural crops.

### **Key Messages**

- Genetic markers have many applications in the management of genetic variation in tree and crop breeding programs. The most common application of markers today is in backcross breeding (introgression).
- Neutral markers can be used to enhance breeding designs.
- Strategies for use of MAS in forest trees include forward and backward selection, early culling, skipping generations, and mate selection, though not all programs will be amenable to all options.
- The economics of MAS in forestry may be attractive but adoption of the technology will require convincing evidence of success.

### **Outcomes**

Course attendees will:

- Gain an understanding of how genetic markers can play important roles in managing crops today.
- Gain insights into how, when and where MAS may be applied in traditional tree improvement programs.
- Learn how to evaluate the economic merits of logistically feasible but complex and expensive genetic applications such as MAS.

### **Future Outcomes**

We anticipate that in future years, we will expand this module to include specifics of how to apply association genetics (LD and GENE MAS) detailing index selection and BLUP protocols.

## **Module 8: Implementation Strategies and Economics of MAS in Tree Improvement Outline**

- I) Marker Assisted Management of Genetic Variation
  - A) *Quality Control*
  - B) *Characterizing Propagation Populations*
  - C) *Hybrid Breeding and Introgression*
    - 1) Mate Selection
    - 2) Backcross Breeding
  - D) *Enhanced Breeding Designs*
    - 1) Complementary Breeding
    - 2) Index Breeding
    - 3) PMX/WPA
- II) Implementation Strategies for MAS in Tree Improvement
  - A) *Scenario 1: Standard Complementary Breeding with Mainline and Elite Populations*
    - 1) Case 1b: Selecting Individual trees
    - 2) Case 5: Culling Orchards
    - 3) Cases 3/7: Early Culling
  - B) *Scenario 2: Polymix Breeding with Paternity Analysis – No pedigree crosses*
  - C) *Scenario 3: Complementary Breeding with Skipped Generations of Field Testing for Elite Crosses*
    - 1) Case 4: Mate Selection
- III) Modeling Gain and Econometrics