

## **Module 2: Introduction to Conventional Tree Breeding**

### **Introduction**

Module 2 is designed to show how basic concepts of population and quantitative genetics (Module 1) are used to guide elements of a tree breeding program. It explores the fundamentals of the tree breeding cycle (breeding, testing and selection) while conveying the distinction between various types of populations of interest: base, breeding, selection and propagation. Module 2 develops the foundation needed to introduce the concept of MAS applications in forest trees (Modules 7&8).

### **Key Messages**

- Genetic improvement in forest trees typically means the application of quantitative genetic principles to population improvement for a finite number of traits related to wood quantity and quality.
- Tree improvement is based on the tree breeding cycle which, though conceptually straight-forward, can be time-consuming, costly, and quite complex in its application.
- Key concepts associated with crop improvement include genetic gain, heritability, genetic correlation, selection intensity, variance components, multi-trait selection methods and indirect selection.
- Genetic gain is ultimately captured and deployed in plantation forests through improved seedlings or vegetative propagules.
- The temporal, spatial and logistical complexities of tree improvement are sufficiently described to permit later discussion of how, when and where MAS may be integrated into a tree breeding program.

### **Outcomes**

Course attendees will:

- Have a better understanding of the nature of crop and tree breeding practices
- Become conversant in basic concepts of population and quantitative genetics
- Develop a foundation of knowledge upon which the concepts of MAS / MAB can be introduced

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### **Outline**

#### **I. Tree Improvement (definitions)**

- A. *Objective*
- B. *Strategy*
- C. *Tree Breeding Objective*

#### **II. The Tree Breeding Cycle**

- A. *Processes*
  - 1. Breeding
  - 2. Testing
  - 3. Selection
- B. *Populations*
  - 1. Base
  - 2. Breeding
  - 3. Selection
  - 4. Propagation

#### **III. Phenotypic Mass Selection**

- A. *Selection (methods for mass selection)*
- B. *Genetic Gain*
- C. *Selection Intensity*
- D. *Indirect selection*

#### **IV. Breeding and Testing**

- A. *Objectives/Functions*
- B. *Mating Designs*
- C. *Field Designs*

#### **V. Data Analyses**

- A. *Mixed Models*
- B. *BLUP*
- C. *Selecting Traits*
- D. *Multiple trait selection in advanced generations*

#### **VI. Deployment**

- A. *Seedlings - Seed Orchards*
  - 1. OP
  - 2. Family
- B. *Clonal Forestry*
  - 1. Propagation techniques
  - 2. Pros and Cons
- C. *Genetic Diversity*