OUTLINE OF TREE IMPROVEMENT PROGRAM

1. A DETERMINATION OF SPECIES, OR GEOGRAPHIC SOURCES WITHIN A SPECIES FOR AREA OF REFORESTATION.

2. DETERMINE THE AMOUNT, KIND, AND CAUSE OF VARIABILITY WITHIN THE SPECIES OF INTEREST.

3. PACKAGE THE DESIRED QUALITIES INTO INDIVIDUALS TO DEVELOP TREES WITH COMBINATIONS OF DESIRED CHARACTERISTICS.

4. MASS PRODUCE IMPROVED INDIVIDUALS FOR REFORESTATION PURPOSES.

5. DEVELOP AND MAINTAIN A GENETIC BASE POPULATION BROAD ENOUGH FOR THE NEEDS OF ADVANCED GENERATIONS.

RECOGNIZE THE VARIABILITY, ISOLATE IT, PACKAGE IT IN A DESIRED TREE, AND MULTIPLY IT.

TREE IMPROVEMENT TOPICS

INTRODUCTION

HISTORICALLY, FOREST TREES HAVE NOT BEEN VIEWED AS TYPICAL PLANTS HAVING SIMILAR HEREDITY TRAITS TO ALL OTHER LIVING ORGANISMS. GENETIC VARIABILITY WAS IGNORED. IT WAS SOMEHOW FELT THAT A TREE'S DEVELOPMENT WAS DEPENDENT UPON THE ENVIRONMENT IN WHICH IT WAS GROWN.

FOREST GENETICS: THE STUDY OF HEREDITARY VARIATION IN FOREST TREES.
THE OBJECTIVE: TO DETERMINE THE GENETIC RELATIONSHIPS AMONG FOREST TREES AND SPECIES.

THE STUDY OF FOREST GENETICS ORIGINATED IN EUROPE AND IS APPROXIMATELY 300 YEAR OLD. (1717 BRADLEY, ENGLAND) IMPORTANCE OF SEED ORIGIN).

FOREST TREE BREEDING: ACTIONS DIRECTED TOWARDS A SPECIFIC PROBLEM OR TO PRODUCE A SPECIFIC PRODUCT. (e.g. BREEDING TREES FOR DISEASE RESISTANCE)

TREE IMPROVEMENT: GENETIC CONTROLS COMBINED WITH OTHER SILVICULTURAL PRACTICES SUCH AS SITE PREPARATION, FERTILIZATION, AND WEED CONTROL, TO IMPROVE THE OVERALL YIELDS AND QUALITY OF PRODUCTS FROM FOREST LAND.

Foresters manage populations of forest trees⇒ Tree improvement seeks to manage the economically important genetic traits of specific populations of forest trees across generations.

Tree improvement is a component of high input technological forestry, however the genetic composition of a population has important implication for conservation and restoration forestry also.

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VARIATION IN FOREST TREES (cont.)

TYPES OF HYBRIDS

1. INTERSPECIFIC (BETWEEN SPECIES) HYBRIDS

EUCALYPTUS GRANDIS X UROPHYLLA (⇑ VOLUME)
E.GRANDIS X E. ROBUST (⇑ WET SITES)
E. GRANDIS X E. CAMALDULENSIS (⇑ DRY SITES)

2.INTERASPECIFIC (WITHIN SPECIES) HYBRIDS

A.KOA (HAWAII) X A.KOA (MAUI)

E. BETWEEN CLONES

DANGER OF UNTESTED CLONES

HERITABILITY

HERITABILITY: EXPRESS THE PROPORTION OF VARIATION IN THE POPULATION THAT IS ATTRIBUTED TO GENETIC DIFFERENCES AMONG INDIVIDUALS.

BROAD-SENSE: THE RATIO OF TOTAL GENETIC VARIATION IN A POPULATION TO THE PHENOTYPIC (PRIMARY USE IN VEGETATIVE PROPAGATION)

NARROW-SENSE: THE RATIO OF ADDITIVE GENETIC VARIANCE TO TOTAL VARIANCE (MOST COMMON FOREST GENETICS LITERATURE)

GENETIC GAIN: NARROW-SENSE HERITABILITY X SELECTION INTENSITY

MOST CHARACTERISTICS OF ECONOMIC IMPORTANCE IN FOREST TREES ARE UNDER GENETIC CONTROL.

GENETIC DIFFERENCES

GENETIC VARIANCE = ADDITIVE + NONADDITIVE

ADDITIVE: CUMULATIVE EFFECTS OF ALLELES AT ALL GENE LOCI INFLUENCING EACH TRAIT

NON ADDITIVE:

1) DOMINANCE : DUE TO INTERACTIONS OF SPECIFIC ALLELES AT A GENE LOCUS
2) EPISTASIS; DOMINANCE DUE TO NONALLELIC GENES

GENETIC DIFFERENCES CAN BE DETERMINED ONLY BY GENETIC TESTING

A. BETWEEN SPECIES

B. BETWEEN GEOGRAPHIC SOURCES (PROVENANCES)

C. BETWEEN FAMILIES (ALL SEED FROM AN INDIVIDUAL TREE)

1. FULL SIB
2. HALF SIB

D. BETWEEN PURE SPECIES AND HYBRID

HETEROSIS (HYBRID VIGOR) GROWTH SUPERIORITY IN WHICH THE HYBRID EXCEEDS THAT OF BOTH PARENTS

LEVELS OF GENETIC CONTROL

HIGH: WOOD SPECIFIC GRAVITY, ADAPTABILITY TO ENVIRONMENT

MEDIUM: STEM FORM AND DISEASE RESISTANCE

LOW: GROWTH CHARACTERISTICS OF INDIVIDUAL TREES

GENETIC CONSERVATION OF FOREST TREES

CONSERVATION OF FOREST TREE GENETIC RESOURCES, PRESERVES THE POOL OF GENES, GENE COMPLEXES, AND GENOTYPES THAT CONSTITUTE THE SPECIES GENETIC POTENTIAL, TO ENSURE GENETIC BASE POPULATIONS THAT ARE LARGE ENOUGH TO BE PROTECTED FROM EXTINCTION.

IN SITU CONSERVATION: FOCUS ON THE PROTECTION OF ENTIRE ECOSYSTEMS AND NOT INDIVIDUAL SPECIES.

EX SITU CONSERVATION: EFFORTS STRIVE TO ACCUMULATE USEFUL / ALL GENES OF INDIVIDUAL SPECIES ACROSS A WIDE RANGE OF ENVIRONMENTS IN ORDER TO SUPPLEMENT *IN SITU* EFFORTS.

THE GOAL OF GENETIC CONSERVATION EFFORTS ARE TO ENHANCE CONDITIONS FOR FUTURE EVOLUTION OF THE GENETIC RESOURCE.

EFFECTIVE CONSERVATION MEASURES MUST BE INTEGRATED INTO A BROADER CONTEXT OF THE OVERALL MANAGEMENT OF FOREST GENETIC RESOURCES. CONSERVATION MUST THEN BE INTEGRATED INTO A OVERALL STRATEGY THAT INCLUDES EXPLORATION, EVALUATION AND UTILIZATION.

THE QUALITY OF CONSERVATION STRATEGIES WILL DETERMINE HOW WELL USEFUL GENES ARE CAPTURED IN THE PRESENT AND HOW EFFECTIVELY SPECIES EVOLUTION IS ENHANCED IN THE FUTURE. (W.S. DVORAK,1997)