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# Genetic Diversity

## in Forest Management

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### What is genetic diversity?

Genetic diversity is the difference at the gene level between individuals of the same species. Forest geneticists study the patterns of genetic diversity at two general levels:

- 1) differences between trees within a local area, and
- 2) differences between areas or stands of trees across the species range.

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### What is tree improvement?

It is the process of selecting trees with desirable traits (e.g., faster growth, disease resistance) which will be passed on to their offspring. Much research is being done to understand the patterns of genetic diversity for each tree species. Tree breeders use this knowledge to breed, test and select trees.

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### Do plantations from natural stand seed collections maintain adequate genetic diversity?

A cone collection from at least 10-20 trees in a stand will capture a large proportion of the stand's genetic diversity. However, widely planting a single seedlot will reduce diversity among plantations.

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### Are we reducing the genetic diversity in our tree species by planting genetically improved trees?

When selecting for desirable traits, a high percentage of the natural genetic diversity is maintained. Genetic diversity can even be

increased when the offspring of totally unrelated parents, from different areas, intermate in seed orchards.

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### What is a clone?

A clone is a group of genetically identical individuals produced asexually. For example, yellow cedar planting stock can be grown from cuttings. If members of a clone differ, that is, in growth rate, it is due to environmental factors.

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### Are we using clones in our forest plantations?

Currently, the use of clones, through rooted cuttings, exists mainly for yellow cedar and poplar. This method is often used when cone crops are infrequent or seed germination is poor. For yellow cedar, mixtures of many clones are planted to maintain genetic diversity.

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### What is a monoculture?

Two definitions apply: a large area established to a single species (planted or naturally occurring) or a large area planted to a single clone. The second definition applies to some agricultural crops which are more vulnerable to massive losses from new plant diseases.

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### Are we establishing large monoculture plantations?

No. Many forest plantations are established with more than one tree species. Furthermore, each planted seedling is genetically unique, resulting in a significant amount of genetic diversity in plantations.

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### **Do we have programs for maintaining genetic diversity?**

Yes, the Forest Sciences Research Branch is developing strategies for preserving our gene resource both in the wild (parks, reserves, and gene resource management areas) and through tree improvement efforts (gene archives, and test plantations).

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### **What are the benefits of using genetically improved seed over wild stand seed or natural regeneration?**

Depending on the species, plantations from genetically improved seed are expected to grow up to 25% faster than from wild stand seed. In the near future, foresters will also be able to select 'specialty' seedlots for certain traits (e.g., high wood density, weevil resistance, etc.) for operational use.

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### **What effect will alternative silviculture systems have on genetic diversity?**

Alternative silviculture systems (e.g., selection logging, shelterwood) can have either a positive or negative effect on genetic diversity – depending on how they are carried out. With excessive highgrading, overall genetic diversity may not be reduced, but the remaining trees and their offspring will have a higher proportion of less desirable genes.

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### **How will rapid climate change affect trees derived from tree improvement programs and would natural forests be more resilient?**

Trees selected in tree improvement programs have been tested and perform well across a wide variety of environments. These individuals

are expected to be more 'adaptable' to climate fluctuations. In addition, this testing provides information for adjusting the genetic composition of seedlots in response to climate change.

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### **How is tree improvement compatible with integrated resource management?**

Tree improvement programs are designed to enhance the timber resource in plantations, while also managing genetic diversity within commercial tree species. By increasing growth or quality traits in plantations, pressure on the remaining land base to produce timber can be reduced, thereby creating more integrated resource management options.

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### **What effect does forest harvesting have on the genetic diversity of other flora and fauna?**

Harvesting activities may have a severe impact on threatened or endangered species, and care must be taken in these situations. For other species, harvesting should not significantly affect their genetic diversity unless population sizes are severely diminished in a local area. Only careful study of the biology of each species will tell us the exact impact of forest practices on genetic diversity.

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