



Genomics in Forestry: Advancing Sustainability and Climate Resilience

What Are Genomics and High-Throughput Phenotyping, and Why Do They Form a Perfect Team in Forestry?

Genomics analyzes an organism's DNA, revealing the genetics behind traits like growth and disease resistance. The simultaneous use of thousands of DNA markers, i.e. genomic selection (GS), advances forest tree breeding, making it faster and more precise than traditional methods that tend to take decades and overlook resilience to various stressors. However, with climate change the rapid identification and propagation of trees with superior adaptive traits becomes crucial.

High-throughput methods like LiDAR and spectral sensors are increasingly used to fill this gap and will allow for massive phenotyping in breeding populations. Cutting edge research by the Canadian Forest Service (CFS) is integrating GS with advanced phenotyping tools to produce climate-adapted seedlings, aiding future fibre production and carbon sequestration.

Over the last 20 years the CFS has successfully developed genomic resources for Canadian spruces, enhancing breeding programs through genomic selection.



FastTRAC II

- Current Genome Canada funded project
- GS in eastern Canadian black & red spruce breeding programs.

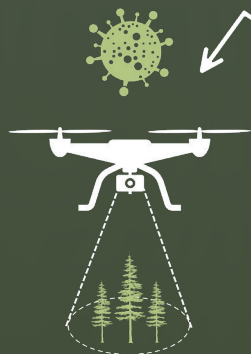
Beyond field trials, seedlings are monitored in greenhouses under stress conditions using gantry-based spectral sensors.



This dual approach helps identify adaptive traits at different growth stages, improving GS application at plantation establishment. Working in end-user breeding plantations or on their seedling material promotes operational uptake of research.

Research Innovations in Genomics & High-Throughput Phenotyping

Drone-based phenotyping in field breeding trials evaluating tree responses to climate stress, such as drought or screening for disease and insect resistance in spruce, western red cedar, and Douglas-fir.



Collaborative genomic and phenotyping research includes universities (e.g. ULaval, UofT, UBC, UVic) and provincial breeding programs in BC, QC, NB, NS, and NL, and industry partner J.D. Irving Ltd.

Key projects funded by Genome Canada and regional centres: Genome BC, Ontario Genomics, Génome Québec and Genome Atlantic

Key Benefits & Success Stories



Operational uptake of GS:

First Canadian spruce breeding programs have included genomic selection in their breeding strategy.



Accelerated deployment of seedlings adapted to climate change:

GS can shorten tree breeding cycles from 25+ years to just 10 years in some species.



More precise selection of superior trees:

Compared with traditional pedigree-based methods, GS allows for better separation of different sources of genetic variance.



Scalable phenotyping in breeding plantations:

Remote sensing tools enable large-scale phenotyping of resistance and adaptive traits that would be too costly and time-consuming to assess.



Increased selection intensity:

The combination of GS with high-throughput phenotyping increases the capacity to identify trees that best combine various desired traits.

 Genomics and high-throughput phenotyping are transforming forest tree breeding, making it faster, more precise, and better suited to a changing climate.

 Canada is at the forefront of integrating cutting-edge genomic research with scalable phenotyping technologies.

 By phenotyping complex growth, physiology, and phenology traits at scale, researchers can better understand how trees respond to climate stressors and select the most productive and resilient genotypes.

 These advancements will help preserve the health, productivity, and resilience of forests for generations to come.

Contact Us:

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