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Canadian Forest Service

CANADIAN WOOD FIBRE CENTRE

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The FastTRAC to first-rate seeds

Every tree has a distinctive genome, carrying the unique genetic information – DNA – needed to maintain that tree's basic functions and growth. A tree's specific genotype (its inheritable set of genes) differentiates it from others. That is why a particular tree can be tall or wide or have a dense canopy.

Certain traits, such as insect resistance or desired wood fibre qualities, are preferred by foresters. Knowing how to produce tree seeds with these desirable traits supports the Canadian forest sector. That is why provinces and territories have worked for decades to establish seed orchards and produce seed sources that meet specific environmental conditions and market demands.

From 2015 to 2019, award-winning researchers from the Canadian Forest Service's Canadian Wood Fibre Centre (CWFC) led the genomic research in a project called ***FastTRAC*** (Fast Tests for Rating and Amelioration of Conifers). This work is transforming traditional tree breeding programs, improving tree selection and equipping seed producers with vital research and tools.

Canada

The FastTRAC project brought together scientists, foresters and economists from Laval University, FPInnovations, the Government of Québec, J.D. Irving and the New Brunswick Tree Improvement Council. They demonstrated tree genomic-assisted selection at the operational scale and highlighted the economic benefits of FastTRAC technology.

Compared to conventional tree breeding and production approaches, which can take up to 30 years to see concrete results, FastTRAC can identify the top performing trees within a few years of growth. This work is among one of the first in the world to apply genomic selection in operational tree breeding.

Starting from the root

In one FastTRAC study, the CWFC's Dr. Patrick Lenz and his team improved genotype prediction for spruce trees. Using genomic relationships rather than the traditional tree species' pedigree (family history) method, they identified valuable tree traits; helping breeders rank and choose seedlings according to the desired traits. This method saves money and significantly shortens the wait times for growing improved trees.

Tree plantations are vulnerable to pest and disease outbreaks, especially as climates change. That is why forest genomics are attractive to tree breeders who understand the economic and environmental value in breeding resilient trees. Patrick and his colleagues also examined the Norway spruce – a non-native conifer in Canada – and its resistance to the white pine weevil, which lead to significant stem deformation. They found that weevil resistance in spruce was significantly influenced by the tree's genes. The team also found that genomic selection offers new possibilities to select for resistant trees that combine preferred growth and wood quality.

In another study, the CWFC's Dr. Yill-Sung Park and Jean Beaulieu (retired) investigated integrating genomic selection with multi-varietal forestry; a commercial tree breeding system that plants a range of genetically different trees. Combining multi-varietal forestry, genomic selection and cell creation, production time for white spruce seedlings was reduced by 15 years. In addition to plant diversity, multi-varietal forestry enables tree breeders quickly adapt to changes in environmental conditions or market demand.

So far, both J.D. Irving and Québec's Ministry of Forests, Wildlife and Parks have taken up these propagation techniques to streamline their foresting practices. This early adoption of the research suggests an upcoming revolution in conventional tree breeding.

Seeds of innovation

The CWFC's work to develop effective and environmentally responsible forestry tools is just budding. We can take the lessons learned from the weevil and Norway spruce and apply them to different trees, insects, genes and ecosystems.

Based on the success of FastTRAC, project partners are exploring expanding the geographic scope and number of tree species to which we can apply this innovative research.

Selecting resistant and valuable trees is just one step to sustain the forest sector through climate change and to boost the value of Canadian trees in the world. As the CWFC accelerates the knowledge and application of forest genomics, we will continue to equip foresters with the knowledge needed to make their trees successful and strong.

Learn more

Visit the project web site:

- http://fasttracproject.ca/en/home/

Also see:

- Lenz, P.R.N., et. al. 2019. Multi-trait genomic selection for weevil resistance, growth and wood quality in Norway spruce. Evolutionary Applications 13: 76-94.
- Lenz, P.R.N., et. al. 2020. Genomic prediction for hastening and improving efficiency of forward selection in conifer polycross mating designs: an example from white spruce. Heredity 124: 562-578.
- Chamberland, V., Robichaud, F., Perron, M. *et al.* Conventional versus genomic selection for white spruce improvement: a comparison of costs and benefits of plantations on Quebec public lands. Tree Genetics & Genomes 16, 17 (2020). https://doi.org/10.1007/s11295-019-1409-7

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