Interprovincial study points to climate-based seed transfer

AdapTree examines how trees react to a changing environment

BY JOHN THOMSON

Local is better. At least, that's been the mantra so far. "It's a safe way to keep trees matched to the climate you plant them in," says University of British Columbia Faculty of Forestry Professor Dr. Sally Aitken. "They've adapted through the process of natural selection."

But climate change is casting doubt on the tried and true. Seedlings that were once well adapted to their environment are showing signs of maladjustment – poor growth and a susceptibility to disease.

"We know temperatures are going up and that climates are getting more variable," says Aitken. It's likely to get worse. Alberta and BC harvest ten billion dollars worth of timber every year and researchers suggest that productivity will decline 10 to 35 percent in the next century if nothing is done to stem the maladjustment to climate problem.

The AdapTree Project is a four year BC-Alberta study which uses climate modelling, geospatial analysis and genomics to come up with a possible solution. The goal is to understand how trees have adapted to their locations in the past and make sure the right seedlings go to the right locations in the future. Genome Canada and Genome BC are the key funders. The University of British Columbia and the research centre, Alberta Innovates Bio Solutions, are the key participants. Dr. Sally Aitken is the project leader. Andreas Hamann, Associate Chair, Research with the Department of Renewable Resources, University of Alberta is the co-leader and heads up the Alberta contingent.

The project focuses on two important commodities, lodgepole pine and interior spruce.

"Those are shared species and it makes little sense to do separate projects," says Hamann "so we simply joined forces for efficiency and a bigger study area. Our lab covers climate change modelling and analysis while Sally's lab leads the genetic screening. Our samples get shipped to UBC and they get prepared there."

The study has grown over 12,000 trees over the past four years and has sampled DNA from all of them in an attempt to determine which genes relate to which traits.

"We looked for certain changes in the DNA code that were associated with particular climactic variables," says Aitken. "For instance did we see one letter in the DNA code common in warm environments and the other in cold environments? The other thing we looked at was drought stress and heat stress and how much energy they put into growing roots versus shoots and then we looked at variations in the DNA code that were associated with those traits."

Aitken sees both provinces moving towards climate-based seed transfer, that is augmenting seeds from the local population with seeds from another location or from seed orchards.

"We might start planting half local and half migrated sees and increase the genetic diversity by planting a mix of different seed sources," she says. "This is one of the lowest cost interventions. If you're already planting, shifting your seed source isn't a very expensive proposition."

The AdapTree Project also includes a series of important sub-projects. For instance, more than half the trees planted come from tree breeding programs. Has human interference affected adaptation?

"We've taken seed from seed orchards for all the breeding zones in Alberta and BC and we're comparing the genetic makeup and the traits of trees from the breeding zones to the natural population so we can understand how breeding has affected that adaptation to climate," says Aitken.

Another spin-off concerns velocity of climate change, that is, how fast do you have to move through the landscape to maintain a constant temperature? Think of a stand of trees in a valley. As the climate warms up, the inclination is to chase cooler temperatures by moving up the mountain. Or as Andreas Hamann says, "Where do I have to go in order to find another place that's comfortable for my trees before they die off?"

The concept was first proposed by University of California, Berkeley in 2009. Hamann and his Alberta contingent have refined the methodology and extended it to include all of western North America. It will tell foresters which places will benefit the most from changing seed sources.

The AdapTree Project is nearing completion and the next step is interpreting the data. Although the results have yet to be made public, Hamann says he will push for seed lot revision. At the moment foresters determine tree breeding zones on the premise nearby populations are relatively similarly adapted.

"Are these seed zones appropriate? Does our genetic data support those zones?" asks Hamann. We found that in British Columbia they are quite well delineated but in Alberta they are too small. So one of our key recommendations is make them bigger. You don't need quite as many seed zones in Alberta as we have right now." ◊