Why Grow the Seed to Grow the Seedling?

BY DAN CRESS

A lot of time and money has been devoted to improving a whole range of tree species. Cattle breeders use similar techniques to improve their dairy herds, but is it practical to address genetics during everyday silviculture? In a word: Definitely.

We plant high-elevation sites with noble fir instead of grand fir: that's genetic selection. Douglas-fir isn't resistant to laminated root rot, yet white pines and cedars are. Maybe plant the pines if you have access to rust-resistant stock and if the rust pressure isn't too severe. Maybe use cedar due to its higher value, especially if those materials have been selected for resistance to deer browse. Consciously or not, silviculturists have been utilizing genetics for ages. Today's technology just allows us to be even more targeted than we have been in the past.

Tree improvement isn't cheap. An alternative would be to avoid planting entirely and hope for the best with natural regen. There are places where this might make sense, but this usually isn't the case here in the Pacific Northwest. Seed zones are available for guiding woodsrun cone collections, so why do we go to great lengths to actually grow the seed to grow the seedlings? Millions of dollars are spent every year to create and manage seed orchards. We even go so far as to control the pollen that pollinates each orchard cone. Orchards can generate large seed with vigorous embryos, big cotyledons, lots of endosperm, and so on. Tree improvement programs are what we use to actually decide what is, or isn't, included within these orchards. Think of orchards as an investment rather than an expense; we wouldn't use them if they didn't make financial sense.

The biggest costs in tree improvement come from breeding and progeny testing. We hand-pollinate female flowers with pure pollen so we know the pedigree of every seed that we sow to generate the test seedlings. Thousands of them are outplanted at a variety of sites where their performance is tracked for a decade or more. The very best selections from those tests are what we use to establish newer and better orchards over time.

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An excellent Douglas-fir cone crop. The cones on these three branches can produce about 10,000 seed.

Consider western hemlock from out on the coastal strip. The first-generation tests involved about 25,000 trees from each of five separate zones. The best of those materials went into seed orchards and were also used as the parents in a second-generation breeding program. Those pedigreed seedlings were deployed at new test sites spread all the way from Newport to the northern tip of Vancouver Island. This means 83,000 *more* selection options that can be used to establish the next round of seed orchards. Want to select for growth at various locations and ages? Want to consider stem form and wood properties? Do Tillamook families growing at Forks give us insights about how trees might respond to climate change? What crosses are we making for the third generation and beyond? The math gets complex, yet this is exactly the type of work that we do, for many species, on a daily basis.

What about seed zones? They imply that local seed will be the best seed. A cumbersome yet better description would be to say that "local seed is a safe bet in the absence of pedigreed data." Woodsrun seed collected from a site is presumably well-adapted to that site, but there could certainly be something just as suited to that environment that grows faster, has better wood properties, has better stem form, and so on. Tree improvement is what we use to compare all of these options.

We have sound data on the performance of each test tree and that of its parents, its cousins, its siblings, etc. Great, so how does growth and adaptation within a test site compare to performance under operational conditions? Realized gain trials have been established to address such questions over time. By no great surprise, tree improvement is a success here in the west just like it has been for things like radiata pine in New Zealand and loblolly pine in the south.

The next step is to adjust the various growth and yield models so they take tree improvement into account. Another line of study is to optimize the trade-offs between traits such as growth, stem form, wood properties, and growth rhythm. These past 50 years' worth of breeding and testing generated 128,000 second- and third-generation selection candidates for some new seed orchards that I designed earlier this year. We can make substantial gains, for an array of traits, when working with populations this huge. I can only imagine what folks will have available to them 50 years from now! ◆

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