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Differences in healing effects of some trees: effects of genes and growing environment

Context

This is a plain-language version of the summary of Anna Bailie's thesis, titled "Phytogeography, genetic variation and antioxidant properties of *Sorbus* ssp. (Mushkuminanatikw) in the James Bay Cree territory of Quebec."

Anna expects to publish her research in two articles and in her thesis. The first of the two articles has already been reviewed by the elders. (See the summary "How growth location might affect a tree's healing properties. A first look at showy mountain ash and American mountain ash.") The second article in not yet ready. The thesis will be ready later this summer. In advance of the complete text, Anna has provided this summary of what will be in her thesis. Some of these findings have also been reported in the lab summaries from the Johns lab.

Goal

The goal of Anna's work was to look at how genes and the growing environment affect the ingredients in two related trees—showy mountain ash and American mountain ash. In turn, this work will help address a much broader question: How and why do plants develop ingredients that are healing for humans?

About trees and healing ingredients

Trees are good sources of medicines for several reasons. First, you can harvest the medicines without hurting the tree much. And a tree's long lifespan allows it to build up a lot of useful ingredients. Trees make certain ingredients to defend themselves against stressors like cold or tree-eating animals. We think that it is these ingredients that have healing effects for humans.

Since a tree makes these ingredients in response to stress, it seems likely that trees growing in colder, more northern areas would have more of them. Anna wanted to test this idea on some of trees that Iiyiyiuch use for medicines, using some new methods for looking at plant ingredients. She used trees collected in twenty different parts of Iiyiyiu Aschii. This included both coastal and inland areas, and four different latitudes (that is, further and further north).

Checking for variations in the trees' ingredients

First, Anna wanted to see if some of the samples actually had more healing ingredients than others. She asked three questions:

1. Do the leaves and bark have equal amounts of healing ingredients, or not?
2. Do the trees from coastal and inland areas have equal amounts of healing ingredients?
3. Does American mountain ash have as many healing ingredients as its "sister" tree, showy mountain ash?

Anna did not look at *all* the possible ingredients in the trees. Rather, she looked for specific ingredients that past studies have shown have anti-diabetic effects.

The results were as follows:

1. The leaves and bark did not have identical ingredients. The leaves made more of some kinds of ingredients, and the bark more of other kinds.
2. The trees from northern and coastal areas had more of the healing ingredients.
3. Showy mountain ash had more of these healing ingredients than American mountain ash.

Are the trees "made" differently, or do they become different because of where they grow?

Trees, like people, inherit certain features from their ancestors. Their genes determine what features they will inherit. We can think of the genes as a cookbook of recipes that the plant can draw on—such as the recipe for parts of a leaf or a root. This is why two American mountain ash trees from different areas will still look much the same: they are "made" using the same set of recipes. But depending on where it grows, a tree might make might more of some of the recipes in its cookbook than others. (This is called "gene expression.") For instance, if the tree is growing in a cold spot, it might make more of the things that protect it against cold.

In short, differences in ingredients can be due to different genes, a different environment, or both. Anna wanted to know if the differences she was seeing were because

- the more northern trees actually have different genes
- the northern trees have the same genes, but respond to stress by drawing more on certain "recipes" from those genes.

She used lab tests to look at the actual genes in the trees drawn from different parts of Iiyiyiu Aschii. (She used the leaves for these tests.) The tests showed that for American mountain ash, the coastal trees actually had slightly different genes than the ones growing inland. But showy mountain ash seemed to have the same genes no matter where it grew—and yet its ingredients varied. Anna concluded that both genes and the environment affect how many healing ingredients a tree will make.

Do the differences in ingredients lead to differences in the tree's healing action?

Anna also wanted to see if these differences in ingredients translate into actual differences in healing action. She tested bark from trees growing in different areas to see if there were differences in how well the bark fights "free radicals." (Free radicals are particles that damage our veins and make them clog up. People with diabetes have lots of them.) Again, Anna found that northern and coastal trees did this more than others. And showy mountain ash did this better than American mountain ash.

All these tests are helping us to understand what gives a plant healing ingredients. Plants growing in northern or exposed areas are likely to have more healing ingredients. But we also see that some kinds of trees have more effect than others, no matter where they grow. In these tests, showy mountain ash always had more effects than American mountain ash. Perhaps this is because showy mountain ash mainly grows further north than American mountain ash does. Now we see why Iiyiyiuch use showy mountain ash more than American mountain ash, and why they use the bark more than the leaves. And we are starting to understand which ingredients give these trees their healing properties.