**The apple tree immunologist**

# Gordon Braun, an ecological plant pathologist

Gordon Braun works on finding substances that will induce the natural resistance of trees. The premises of his work are quite simple: like vertebrates, such as human beings, trees have a natural resistance to disease, but they sometimes become sick because disease-causing are able to overcome that resistance, frequently by reacting faster that the plant can. So, Gordon Braun, an Agriculture and Agri-Food Canada researcher based in the Annapolis Valley of Nova Scotia, is working on boosting the plant's resistance mechanisms before the pathogens arrive: the plant will then be ready and able to protect itself.

There are a number of ways that a plant can respond to a disease attack. When a pathogen attacks a tree, the pathogen exudes various chemicals to help break down the cell wall in order to extract nutrients from the plant, which in turn causes the diseases. But, plants can produce substances that counteract those chemicals and stop or slow down the disease process.

Over 30 of the proteins produced by a plant responding to disease have been identified; they are called Pathogenesis Related, or PR, proteins. While it is not exactly understood how these PR proteins suppress disease, they are known to be part of the process and are present when a resistance response occurs in a tree.

"We know some of the chemicals involved, but everyone is searching for the signaling chemical. It is assumed that there is one chemical that provides a signal, spread throughout the tree, to announce that there is a disease coming in and that the plant should prepare itself, but nobody has identified this protein. We know some of the chemicals of the immune chain reaction, but we are still missing the very first signaling compound" says Braun.

To understand the full defense reaction of the trees, Braun injects substances derived from microorganisms directly in the trunk of trees to induce a defense reaction, such as extracts from the fungus *Venturia inaequalis* that causes apple scab, the disease he wishes to control, and extracts from bacteria that cause plant diseases.

The disease response of a tree exposed to an injected pathogenic substance tends to be short lived, perhaps only 7 days. Energy that the tree puts into a disease resistance response cannot

be used for tree growth, so Braun and his team must strike a balance between disease resistance and tree growth. "It is just a matter of a lot of hard work and it will take time. However, the benefits of this type of disease control are well worth the cost and the effort" says Braun, who is also looking for various other chemicals that have the same effect or a combination of chemicals that would induce more than one disease response.

Amongst the natural plant chemicals known to be a part of the disease resistance response, researchers have identified salicylic acid, the active substance of aspirin. So plants, as well as humans, are using "aspirin" to heal diseases.

"My vision has been to inject a water soluble compound like salicylic acid under the bark of the tree where it will slowly be dissolved in the xylem stream and carried up into the leaves. This would be a slow release process that could provide protection for an entire season with only one application in early spring." To Braun's knowledge, salicylic acid injections have never been done in a woody plant, but theoretically it should work. The main challenge to this approach is to find an economical way to deliver the substance to all of the leaves on the tree.

Braun decided to study fruit production agronomy after working as a high school student on fruit farms in Southern Ontario, where he was born.

"I saw a lot of rotten fruits and I thought maybe we should do something about that" comments Braun, who did a PhD at Guelph University on the epidemiology of Botrytisis, the gray mold that affects strawberry crops. He then joined AAFC in Nova Scotia, where he has been working for 25 years as a plant pathologist, clearly motivated by the reduction of the use of chemicals for the treatment of plant diseases.

The syringe (Wedgle Direct-Inject from ArborSystems) injects a liquid solution under the bark through a rubber septum. This injection will induce a resistance reaction in the tree and helpresearchers understand how trees fight diseases.

"My approach was to find ways to reduce sprays for controlling apple scab. There is an economical advantage for the growers in reducing pesticide use, but my first interest was to reduce the impact to the environment. Pesticides don't only kill pathogens, they destroy the good fungi of the soil that are very important in recycling nutrients and they may reach the water systems, such as streams and wells," says Braun. And his perseverance has paid off, as he has been involved in the development of many successful "sustainable" agricultural projects.

One of these sustainable approaches was the treatment of "apple replant disease" with compost. This disease, which occurs on the roots of apple trees, slowing down their growth, was traditionally treated with the application of fumigants that are toxic and kill more than the targeted pathogen. Compost had been tried to help combat this disease, but without conclusive results. Braun was innovative in reassessing how compost should be applied - rather than mixing it at the surface of the ground beneath the trees, he ploughed a trench and filled it with

compost, putting the soil back on top, and planted the trees in the middle of that trench. The tree could then produce roots that grew through the pathogen-free compost, with ample moisture and nutrients that are released slowly over time. This gives the tree a really good start in the first year, allowing trees grown in compost to be twice the size of those grown in regular soil.

Braun is also working on angular leaf spot in strawberries, a bacterial disease. Bacterial diseases are very difficult to treat because bacteria do not respond well to chemicals. Some considered the use of antibiotics, but pesticide regulators do not like using antibiotics in the field, a treatment that should be restricted to humans. Looking for an alternative, Braun stumbled upon a substance that is a very simple, non-toxic and natural organic compound used on all kinds of food products and which amazingly controls the disease far beyond expectations.

Tracking microbial pathogens is not an easy job, admits Braun. “Unlike insects or weeds, you can’t see them. That is the problem. You don’t see the spores or the bacterial cells that float in the air - they come out of nowhere when you don’t expect them to show up and cause diseases. And when you see the disease, it is too late. And you can’t sell apples that have spots on them, people will not buy them” says Braun, adding that Nova Scotia’s wet and cool spring is very suited to apple scab, unlike dry areas such as the Okanagan Valley or Washington State.

But the Nova Scotia Fruit Growers Association is helping a great deal and is very supportive of Braun, who will do research with any budget he receives. He also comments that AAFC has always been very supportive in all of the projects that he has pursued.

Having a very curious mind, Braun is thrilled and marveled by discovering how nature works. He is planning to do some work in the Third World once retired. In the meantime, he cultivates his patience while watching trees that grow so very slowly, and he fights stress by riding his motorcycle.

After a stressful day, when the weather is nice, a ride on his Honda VTX Custom motorcycle makes him feel wonderful by the time he gets home. It surely immunizes Braun against bad germs; it is now scientifically documented that pleasure works better than salicylic acid for relieving stress!

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