IMMUNIZING APPLE TREES

A STUDY OF GORDON BRAUN'S TECHNIQUES

By Nicole Boudreau

Gordon Braun looks for substances that will induce the natural resistance of trees.

Like human beings, plants have a natural resistance to disease. They become sick when disease-causing organisms are able to overcome that resistance. Braun is a researcher with Agriculture and Agri-Food Canada (AAFC). With the Organic Science Cluster (OSC), Braun is working on boosting the resistance mechanisms of plants.

Induced resistance

When a pathogen (disease-causing organism) attacks a tree, it exudes chemicals to help break down cell walls and access the nutrients inside. Disease can result. However, plants can produce substances that counteract those chemicals and stop or slow down the disease process.

Researchers have identified more than thirty pathogenesis-related (PR) proteins that are produced by a plant responding to a pathogen. It is not exactly understood how PR proteins suppress disease.

Salicylic acid, the active ingredient of Aspirin, is one of the natural plant chemicals involved in the defence response.

"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, [which is] spread throughout the tree, to announce that there is a disease coming in so that the plant can prepare itself. But nobody has identified this protein," says Braun.

Braun injects substances derived from microorganisms into tree trunks to induce a defence reaction. These substances include extracts from *Venturia inaequalis*, the fungus that causes apple scab (the disease he wishes to control) and extracts from bacteria that cause other plant diseases.

The disease response of a tree exposed to this injection lasts a short time, perhaps only a week. The 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 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," explains Braun, who is looking for chemicals or a combination of chemicals that would induce more than one disease response. For example, researchers have identified salicylic acid, the active ingredient of Aspirin, as one of the natural plant chemicals involved in the defence response.

Braun's 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 performed in a woody plant, but, theoretically, it should work. One challenge is to find an economical way to deliver the substance so it reaches all the leaves on the tree.

Braun's background

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

"I saw a lot of rotten fruit and I thought maybe we should do something about that," says Braun. He completed a PhD at the University of Guelph on the epidemiology of Botrytis, the gray mould that affects strawberries. He then joined AAFC in Nova Scotia,

where he has been working as a plant pathologist for 25 years. He is motivated by the goal of reducing the use of chemicals to treat plant diseases.

"My approach was to find ways to reduce [the use of] sprays for controlling apple scab. There is an economic 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," says Braun. He adds that the pesticides might also "reach the water systems, such as streams and wells."

Braun's concern for the environment has led to the development of many successful sustainable agricultural projects.

Apple replant disease

One sustainable approach is the treatment of apple replant disease with compost. This serious rootborne disease is treated conventionally with toxic fumigants. Compost applications have been used to help combat this disease, but without conclusive results.

One approach to the treatment of apple replant disease is with compost.

Braun was creative in reassessing how compost should be applied. Rather than applying compost to the ground beneath the trees, he filled a trench with compost, put the soil back on top, and planted trees in the trench. The tree roots could then grow through the pathogen-free compost that contains slow-release nutrients. This gives trees a good start in the first year, allowing trees grown in compost to be twice the size of those grown in regular soil.

A solution is injected under the bark to induce a resistance reaction and help researchers understand how trees fight diseases.

Angular leaf spot

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.

The hidden problem of pathogens

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 well suited to apple scab, unlike dry areas such as the Okanagan Valley or Washington State.

Perhaps for this reason, the Nova Scotia Fruit Growers Association is supportive of Braun. He adds that AAFC has always been very supportive of his projects.

Braun is thrilled 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.

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Photo credit: Atlantic Food and Horticultural Research Centre