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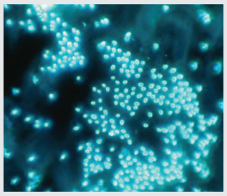
In Brief






from the Canadian Forest Service – Laurentian Forestry Centre

Number 12 – 2007

Vaccines for trees?

Trees have built-in defence mechanisms that can be stimulated. Poplars naturally produce enzymes that help protect them against pathogens and environmental stressors. By finding ways to artificially stimulate this natural resistance, scientists hope to be able to develop vaccines for trees. Artificial stimulation of plants' defences against disease is an approach that is already used for vine and cereal crops.

The defence mechanisms of trees are more complex than those of other plants, mainly because of their longer period of growth. Researchers with the Canadian Forest Service, the Université de Sherbrooke and the University of British Columbia have found a way to stimulate defence responses in trees by using chitosan, a substance typically produced in response to pathogen attack. The researchers also tested the effect of ozone, a low-altitude air pollutant that has a strong oxidizing effect. They found that the exposure of plant cells to ozone likewise triggered defence mechanisms in trees. These findings indicate that it should be possible to develop vaccines for trees that afford protection against insects and disease. Trees also use physical barriers and antimicrobial compounds as part of their defences against invaders such as insects and pathogens.

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White pine blister rust: more of a challenge than expected

Photo: C. Aerni

White pine blister rust, caused by the fungus *Cronartium ribicola*, was accidentally introduced from Europe in the early 20th century. This disease has a devastating effect on plantations and natural stands alike. To complete their life cycle, fungi that colonize eastern white pines need to release spores to infect *Ribes* spp. (currants and gooseberries) before they can reinfect white pine needles.

The customary disease control approach of eradicating *Ribes* spp. has never been completely effective. A Canadian Forest Service study has provided an explanation for this: the fungal spores have the ability to travel a lot farther than previously thought, and genetic recombination resulting in new variants of the fungus may be an obstacle to developing varieties of eastern white pine and *Ribes* spp. with greater resistance to the disease. These factors represent an impediment to efforts to control white pine blister rust in the most majestic coniferous species of eastern North America.

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A new tool for fighting spruce budworm?

Tebufenozide, an artificial hormone related to the natural hormone that triggers moulting in insects, has the ability to interfere with spruce budworm development and reproductive success when it is ingested by budworm larvae. A recent study by researchers with the Canadian Forest Service and Université Laval shows that the ingestion of a sublethal dose prolongs larval development, delays mating initiation, slows egg maturation and affects the male orientation response to sex pheromones released by females. Tebufenozide also has a negative effect on various other aspects of the reproductive systems of males and females.

Research in this area is aimed at discovering more selective and safer chemicals for controlling targeted pests. Tebufenozide, sold under the name Mimic®, is one of these new kinds of pest control products. Although the product's toxicity has already been demonstrated in budworm species, researchers have only begun to gain more insight into how it works.

The spruce budworm is one of the most damaging insects for the softwood and mixedwood forests of Quebec and eastern Canada. The study on tebufenozide also covered the obliquebanded leafroller, which is known to be an alternate host for some spruce budworm parasitoids. The lower toxicity of tebufenozide to obliquebanded leafroller larvae, as revealed in this study, should help to protect a proportion of these parasitoids if the product comes into use against spruce budworm populations. This is an aspect that should be investigated in the field in future research.

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Bird's eye maple: gaining insight into this figured grain

The figured grain found in bird's eye maple results from abnormal cellular growth in the cambium, a layer of living cells between the bark and the wood of the trunk. This pattern, which makes bird's eye maple very valuable, has long intrigued scientists. A team of researchers from the Canadian Forest Service, the University of Tokyo, CERFO and Cégep de Sainte-Foy has just published a microscopy-based study into the formation of the bird's eye grain. The study results suggest that this grain pattern represents a stress response and that the hormone ethylene may be involved in inducing its formation.

The commercial value of bird's eye maple is 5 to 15 times greater than that of non-bird's eye maple wood. Although the figured wood is highly prized by industry, there are still many gaps in our understanding of how the bird's eye grain pattern forms. In the past, factors such as heredity, pathogenic microorganisms and certain growing conditions were put forward as possible explanations for the phenomenon, but no satisfactory evidence was found for their role. Although more common in sugar maple, the bird's eye pattern is also found in other deciduous species such as American white ash, yellow birch, white birch and red maple and even in conifers such as jack pine. Bird's eye maple makes up less than 1% of the total production of maple wood. Attempts to induce vegetative reproduction of bird's eye maple have so far failed. If we want to be able to cultivate bird's eye maple, we will need to learn more about the mechanisms involved in its formation.

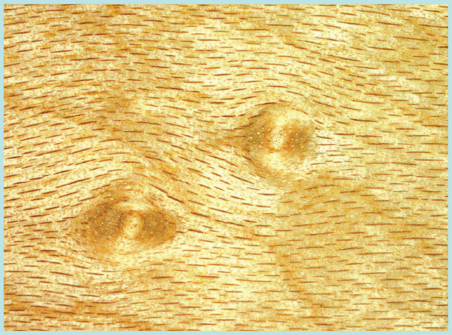

Photo: D. Rioux

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A genetic marker for more effective investigations of poplar leaf rust

Rusts are common diseases of agricultural crops and tree species that cause significant economic losses every year. In poplars, leaf rust is the most prevalent disease around the world. It causes poplar leaves to drop early and reduces height and diameter growth in affected trees, leading to mortality in the most severe cases.

Photo: A. Carpentier

Canadian Forest Service researchers have developed a new, more effective method for studying poplar leaf rust. This approach, which uses genetic markers developed from the analysis of the DNA of the yellow-orange rust pustules, circumvents several problems that hampered the investigation of this disease in the past. To identify this rust disease by the conventional method, it is necessary to culture the causal fungi by infecting poplar leaves or young seedlings, a process that must be repeated for each sample, making the procedure very time-consuming. The new method can be used to treat a large number of samples much faster.

Rust diseases are caused by members of the lower fungi that require an alternate host plant to complete their life cycle. In the case of poplars, the spores released on the leaves eventually infect larch needles and later reinfect poplar leaves.

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Defensins: natural defence mechanisms

The results of a recent study by Canadian Forest Service and INRA researchers have provided insight into the molecular structure of a defensin found in white spruce. Defensins are proteins that are activated naturally in living organisms to protect against the invasion of bacteria and fungi. They are known to be active in insects and mammals.

In plants, defensins are present at entry points such as around stomata, the tiny organs on leaves that are involved in gas exchange with the atmosphere. These defence mechanisms are capable of producing antibacterial agents such as hydrogen peroxide and ethylene.

A better understanding of the genetics of defensins would enable researchers to develop varieties of agricultural and forest plants that are more resistant to insects and disease. Defensins are not toxic to insects or other plants. In agricultural research, the genetic knowledge of a specific alfalfa defensin was used to produce a variety of potato capable of resisting a widespread fungal disease.

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