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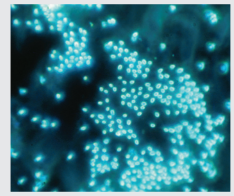
In Brief

from the Canadian Forest Service – Laurentian Forestry Centre

Number 18 – 2009






Lightning study in Quebec

In Canada, almost 2.7 million electric discharges occur annually and are responsible for nearly 4,000 forest fires. These fires represent 35% of forest fires ignited, but 85% of the area burned. In Quebec, these proportions remain roughly the same. According to the Société de protection des forêts contre le feu (SOPFEU), 34% of fires are caused by lightning, but they account for 95% of the area burned.

Researchers with the Canadian Forest Service carried out the first study about lightning for the Quebec territory using data from Hydro-Québec. The study covered a ten-year period (1996-2005) and took into account the polarity (positive or negative) of the electric discharges. Positive strokes could be important in the ignition of forest fires because they contain more long direct current than negative strokes.

The territory covered by the study is located south of the 53rd parallel and totals more than 1,000,000 km². The database contained nearly 4,000,000 ground electric discharges. The first goal of the study was to describe the temporal and spatial patterns of lightning and its polarity.

Photo: J. Morissette

Temporally, the annual number of electric discharges and the ratio between negative and positive lightning (76/24) varies only slightly from year to year. Even if lightning remains active year-round, it occurs more often during June, July and August. However, even if there were 239 days of lightning per year on average, 90% of the lightning strikes were clustered over only 44 days.

The spatial distribution of the lightning flashes reveals a higher density in the southern and western parts of the province. The St. Lawrence Lowlands receive the highest number of electric discharges. The spatial distribution of the percentage of positive discharges varies considerably, ranging from 0 to 65% depending on the location. Although the St. Lawrence Lowlands have the highest density and the most days of lightning, we observed the lowest number of positive discharges in this region.

The researchers' next step will be to determine the correlations between the lightning flashes and the meteorological conditions that are conducive to igniting forest fires.

For information: Jacques Morissette, jacques.morissette@nrcan-rncan.gc.ca

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Fungal endophytes unique to black spruce

The colonization of needles by fungal endophytes is a well-known phenomenon in conifer species such as fir, spruce and white pine. These fungi, often microscopic, live inside the needles and other tissues of the trees. Their functions are not well understood, but researchers believe they may play an important role in the defense against pests. Studies have shown that certain endophytic species found in fir and spruce needles are involved in the resistance against the spruce budworm. These fungi may contain future biological pest control tools.

A researcher with the Canadian Forest Service in collaboration with colleagues from Université Laval studied the latitudinal distribution of fungal endophytes in black spruce. Their work made it possible to observe more than 44 fungal species. The researchers noted that the number of rare species was higher in the southern and western regions than in the northern ones. They also noted that species diversity decreases as you go north.

The researchers also identified 18 rare fungal species unique to black spruce, including for the first time a fungal endophyte that is also an aquatic fungus. This discovery is important because in the boreal forest, algae photosynthesis is only a minor factor in the food chain in streams; spruce and jack pine needles provide the basis of the food found in watercourses. Yet, the fungus that colonizes tree needles is also the one that decomposes them once the needles fall in the water, making them available to the zooplankton and the rest of the food chain.

Photo: J. Bérubé

Since the properties of fungal endophytes are not well known, researchers insist on the importance of protecting the genetic diversity of black spruce in order to protect the diversity of their endophytes.

For information: Jean Bérubé, jean.berube@nrcan-rncan.gc.ca

This publication is part of a series that presents popularized summaries of scientific articles written in whole or in part by Laurentian Forestry Centre researchers.

Canada

InBrief from the Canadian Forest Service – Laurentian Forestry Centre

Pest insect control: Biotechnologies to the rescue

Recent progress in the application of molecular biology to insect studies has made it possible to uncover mysteries pertaining to insects that had remained difficult to solve up until now as well as to develop new methods of controlling the less desirable elements of this six-legged fauna. To take stock of the situation, a Canadian Forest Service researcher did an overview of the use of biotechnologies in insect research.

Here is what emerged from this document:

- Studying the genome of insects has made it possible to identify genes specific to insects or to small groups of insects, thus facilitating the development of control tools specific to pest species that therefore have a low impact on non-target organisms.

Photo: C. Germain

- An analysis of the composition and function of genes will make it possible to compare insect populations and identify the genes that contribute to an insect's resistance to an antiparasitic treatment. It will then become possible for researchers to adapt their management strategies in order to circumvent this resistance.
- Biotechnologies have also made it possible to determine the (evolutionary) taxonomic relationships between insects by using genomic information to establish parental relationships between various groups of insects. Researchers will therefore be able to develop control strategies and products that are better adapted to these pests.
- The use of genetically modified organisms is another way of controlling pests. Certain types of genetically modified plants capable of producing an insecticide when attacked were tested and used on a commercial basis with considerable success. Researchers are also working on genetically modified microbial agents that offer the advantage of being specific to one particular pest species. Moreover, work is underway to develop genetically modified insects that will transmit a lethal gene to their progeny once they are released into nature. We believe that this type of approach could be effective in fighting diseases that are transmitted by insects, such as malaria or yellow fever.
- The identification of target proteins probably is the biotechnological contribution with the greatest potential for application in insect genomics research for antiparasitic control. The identification of these types of proteins (enzymes and receptors specific to insects) should make it possible to develop biorational insecticides, i.e. products whose active ingredients have a specific antagonistic effect on the target protein, and therefore little or no impact on organisms that do not produce the protein in question.

Although progress in the study of insect genomics has been slower than that made in biomedical sciences, a number of tools resulting from this research already make it possible to develop new methods of controlling insect pests. Biotechnologies are therefore another tool that is available to researchers whose work involves controlling insect pests.

For information: Michel Cusson, michel.cusson@nrcan-rncan.gc.ca

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Using fungi to control the white pine weevil

The white pine weevil is a significant pest in several conifer plantations. This insect has significantly reduced the use of Norway spruce and white pine in plantations in Quebec. In British Columbia, this insect also causes considerable damage to Sitka spruce.

Several simple and effective silvicultural methods developed by Canadian Forest Service researchers can be used to control this weevil. However, these methods do not prevent damage and treatments must be repeated annually during the period when the plantation is most vulnerable. Because the weevil's biology is such that larvae develop beneath tree bark, it is difficult to reach them. It therefore becomes necessary to develop a control method that targets the adults when they are in the litter in the spring and fall, and thereby reduce silvicultural control efforts.

Canadian Forest Service researchers in Quebec and British Columbia combined their efforts to form the ECOBIOM* group, which aims to develop a biological insecticide from entomopathogenic fungi. In order to find the most effective isolates to control the weevil, the researchers confirmed the virulence of 27 fungal isolates of the genus *Lecanicillium*, which occurs naturally in the weevil's environment in British Columbia. Their work showed that, depending on the isolate used, mortality varied from 20% to 100%. For one isolate that caused 75% mortality among adults, the median lethal dose (LT50) was of 7 days at 20°C. However, the researchers also noted that the infected weevils could transmit the fungus to other healthy individuals. The ground litter environment supports the survival of fungi, and this approach could therefore reduce the populations when they are inactive under the tree litter.

The next step in developing a bioinsecticide against the white pine weevil is to perfect the technique in order to use the best isolates in a natural environment.

*ECOBIOM: Extended collaboration on biological control of forest insects or pathogenic microorganisms

For information: Robert Lavallée, robert.lavallee@nrcan-rncan.gc.ca

For more information about the series:
Natural Resources Canada
Canadian Forest Service
Laurentian Forestry Centre
1055 du P.E.P.S.
P.O. Box 10380 Stn. Sainte-Foy
Quebec (Quebec) G1V 4C7
418 648-5789

cfs.nrcan.gc.ca/publications/series/read/2

 ISSN 1925-5756