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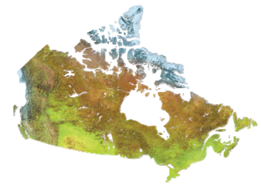
The Great Lakes Forestry Centre (GLFC)



Bt - a forest biopesticide success story

Overview

Over several decades, Canadian Forest Service researchers have played a significant role in developing the biopesticide Bacillus thuringiensis (Bt) to combat forest defoliators such as the spruce budworm and gypsy moth. Improvements in product formulation and application technology have been made to enhance its efficacy against a wide variety of forest and agriculture insect pests.

Bacillus thuringiensis, commonly referred to as Bt, is a biopesticide that was developed from a naturally occurring bacterium found in soil. It is currently the most successful commercial product for use against forest pests, and is used widely in aerial forest protection programs in Canada and throughout the world. It is currently the most effective tool for control of spruce budworm. Research and development work on biological control agents such as bacteria, viruses and fungi was started at the Laboratory of Insect Pathology, which opened in Sault Ste. Marie in 1950.

During the first 15 years of research at the laboratory, a good deal of pioneering work was conducted on understanding the fundamentals of infection and mode of action of Bt. Scientists determined that the toxicity of Bt lay in protein crystals that are produced when the bacteria form spores. When a susceptible insect ingests these crystals, its gut cells are affected, which causes the insect to stop eating and die within a few days. This research led to the first experimental aerial applications of Bt in 1960. These first trials were not highly successful, but progress was made a few years later with the discovery that the *kurstaki* variety of Bt was more toxic to Lepidoptera (butterflies and moths), and it was subsequently adopted for commercial production by the mid 1960s.

During the 1970s, many field trials were conducted to improve the effectiveness of Bt, largely for control of spruce budworm. Potency of the formulations was increased, and these more concentrated products reduced shipping costs, permitted application of lower volumes and improved spray plane productivity. From 1985 on, Bt was applied at 20 or 30 BIU/ha in 1.6 or 2.4L.

Spray technology that allowed for small droplets also led to improved success. Good control of the pest depends on the number of droplets an insect ingests and how much Bt is in each droplet, so spray formulations must produce droplets of a certain size and toxicity. It was determined that small droplets are best applied with rotary atomizers, which are capable of generating a high proportion of droplets in the appropriate size range, with flow rates below 2L/min.

Since 1985, Bt has been used on nearly 8 million hectares of insect-infested forests. In addition to controlling spruce budworm, Bt has been used successfully against other defoliating insects, including western and black headed budworm, gypsy moth, eastern hemlock looper, forest and eastern tent caterpillar, and whitemarked tussock moth.

Research on the mode of action of Bt at the organism and population levels has contributed to the development of a detailed spruce budworm-Bt efficacy model, which will improve the way Bt is applied against forest defoliators. Together with other decision support models, which permit better spray planning, more accurate spray application, and better on target droplet deposition, these tools will enable forest managers to use Bt more effectively and more sparingly to protect our forests during the new spruce budworm outbreak.

The development of Bt into a commercial pest control product is indeed a success story and CFS researchers played a critical role its development. Its success in forestry and its outstanding environmental safety have led to worldwide commercial interest in Bt use in agriculture and other markets.

GLFC Webinar Report

On March 20th, 2012 the Great Lakes Forestry Centre (GLFC) presented the third in its webinar series. The web conference discussed the Traits of Plants in Canada (TOPIC) Network, which is a Canadian Forest Service-managed initiative that facilitates collaborative research through a functional trait approach. The TOPIC Network includes participants from national, provincial, university and industry in Canada. Dr. Isabelle Aubin explained the challenges of integrating ecological data from different sources and the characteristics of a functional trait approach. She explained that the TOPIC Network facilitates the exchange and sharing of data and increases the collaboration between researchers. To access her presentation please visit the following site: ftp://ftp.nrcan.gc.ca/cfs/glfc/ For more information on the TOPIC Network, please see Frontline Express # 57 or contact Great Lakes Forestry Centre.

Leadership changes at Great Lakes Forestry Centre

Overview

Dr. David Nanang was appointed Acting Director General, Great Lakes Forestry Centre, on a one year developmental assignment, effective March 6, 2012.

Rod Smith will retire from the Canadian Forest Service on May 31, 2012 after a long and illustrious career spanning five decades.

David joined GLFC in 2009 as the Director, Forest Ecology, coming from Indian and Northern Affairs Canada where he was Senior Policy Advisor. David has previous experience in CFS working as a Forest Economist in the Policy, Economics and Industry Branch in Ottawa from 2003 to 2005 and as a Contract Researcher at Northern Forestry Centre from 2000 to 2002. Prior to coming to Canada, David held forestry positions in his native Ghana with the Forestry Department and as Lecturer in Forestry at the University for Development Studies.

David has a B.Sc. in Natural Resource Management from Kwame Nkrumah University of Science and Technology. He has a M.Sc. in Forestry from Lakehead University and a Ph.D. in Forest Economics from the University of Alberta.

Rod Smith will retire from the CFS on May 31, 2012 after a long and successful career spanning five decades. Rod first worked with the CFS in 1978 at the Petawawa Forest Research Institute in Chalk River and then rejoined CFS at GLFC in Sault Ste. Marie in 1981. At GLFC he began in the Mechanization of Silviculture Unit, and concluded his career as Director of the Operations and Spatial Analysis Division.

Peatland fires are increasing carbon emissions

Overview

With increasing fire frequency in the boreal ecosystem Great Lakes Forestry Centre researchers are working with international collaborators to better understand the effects of peatland fires on carbon emissions to best allocate limited fire management resources and to improve policy decisions to meet these expected changes.

Fire is important to the ecology of forested ecosystems in Canada. With a warming climate it is predicted by various modelling scenarios that forest fires will burn more than twice the area annually by end of the century. Boreal peatlands compose 2-3% of the earth's land area, represent 25-30% of the boreal forest region and store close to 30% of the world's terrestrial carbon. With an increased frequency of fires on the landscape these peatland carbon stocks are increasingly at risk of being burned, which would increase the amount of carbon entering the atmosphere thus further accelerating the effects of climate warming.

While wildland fire has been extensively studied in the boreal ecosystem less is known about the risk of boreal peatland fires. With the increasing frequency of forest fires in North America and more fires occurring later in the season, during the time when water tables are usually lower, peatlands will be put at increased risk of burning.

Great Lakes Forestry Centre researchers are studying peatland fires as part of their efforts to measure and predict their effect on climate. Part of this work includes the establishment of baseline information on recent fire activity, which can be used with climate models to predict future fire intensity, frequency and impacts.

Based on sampling of peat cores researchers have learned that peatlands typically burn less often (80 to 1100 years) than the boreal forest (50 – 500 years). Researchers have also learned from international research efforts in Indonesia, where peatlands are much less common than the boreal forest, that the 1997 peatland fires released the equivalent of 20-50% of global carbon emissions. Preliminary estimates of the effects of increased fire frequencies in the boreal peatlands indicate significantly increased emissions of carbon and other noxious materials such as mercury into the atmosphere, which may seriously threaten human health. Furthermore, peatland fires are difficult to extinguish and have a tendency for long-term smouldering, resulting in increased releases of carbon into the atmosphere.

Another concern is that climate change is expected to increase the rate of permafrost thaw, which will increase the area at risk of fires.

International collaboration will be necessary to better understand the expected changes in fire frequency and intensity in boreal forest peatlands and their anticipated impacts on climate warming across the boreal region.

With these expected changes, knowledge gained from wildland fire research will be a critical tool to help best allocate limited fire management resources and to improve policy decisions.

For more information, please see Frontline Express #50 or contact Great Lakes Forestry Centre.

Upcoming 2012 webinars

Mark your calendars for these upcoming presentations.
Subscribers to the GLFC e-Bulletin will receive an e-mail notification with complete details in advance of the webinar.

Date	Time	Title	Presenter
September 18th	1:30 p.m. Eastern	The role of environmental variables in predicting jack pine budworm outbreaks in Northern Ontario	Dr. Chris MacQuarrie
November 20th	1:30 p.m. Eastern	The function and fate of peatlands in a warmer world.	Dr. Kara Webster

Using computer models and risk maps to improve invasive species management

Overview

Preventing or minimizing impacts of invasive pests on forests requires the identification of areas that are threatened by invasive species. Great Lakes Forestry Centre (GLFC) scientist, Denys Yemshanov is developing new predictive risk assessment and mapping tools to support efficient and effective decisions about the management of invasive species in Canada. Knowing where, and to what extent, invasive species may become established allows management efforts to be focused on stopping or slowing their spread to minimize economic and environmental impacts.

Insects, diseases and plants that do not normally occur in Canadian forests can cause serious environmental and economic problems if they are introduced. Invasive species can harm natural ecosystems by out-competing native species, thus reducing biodiversity. If invasive species cause damage to trees that could be harvested or to trees on public property, the economic impacts can affect industry and government. Forest companies can lose revenue if large areas of the managed forest are affected by invasive pests. And municipalities may have to treat, remove and/or replace trees attacked by invasive species in the urban forest.

Many invasive organisms arrive in Canada with packing material used in transporting imported goods from other counties. But the arrival of an invasive species from abroad does not necessarily mean that it will spread and become a major problem. First, the invader has to be able to survive in Canada. Second, the invader has to escape undetected from the port of entry. And third, the invader has to be able to move into other areas.

Preventative measures that guard against invasions can be implemented in areas that are identified as being at risk. Knowing which areas are at risk allows managers to make better decisions to stop or slow the spread of the invasion if, or when, it occurs. Great Lakes Forestry Centre (GLFC) scientist Denys Yemshanov is applying computer modelling to enhance such knowledge of pest invasions. His work currently focuses on high-priority invasive forest pests and is being carried out in collaboration with the United States Department of Agriculture-US Forest Service, Michigan State University, and University of New Hampshire.

Computer models and maps are used to predict the chances of an invasive species spreading to a particular area, and to estimate the level of damage that can be expected from the invasion. These predictive models incorporate existing information about where pests are currently found, how and where they entered the country, and where their preferred food is located.

In addition, human activities, like trade, are analyzed to predict how invasive species might move around, such as through the transportation of imported goods across the country. Maps show the risks of invasion along major transportation routes. Producing such risk maps for invasive species is challenging because a large amount of information is required, some of which may be incomplete, which can lead to some uncertainty in the predictions of risk depending on how much information is missing. But decisions must be made about the management of invasive species whether or not all the information is known. New techniques are being used to identify the level of uncertainty in risk maps, which helps in producing more accurate predictions of the spread of invasive species.

Ultimately, these computer models and maps provide forest managers and municipalities with tools that allow for more effective decision-making and improve their ability to deal with invasive forest pests.

For more information please refer to Frontline Express 51 or contact Great Lakes Forestry Centre.

GLFC recent publications

If you would like to order any of the publications listed below, please contact Publications at the following e-mail address: glfc.publications@nrcan.gc.ca

Aubin, I. 2012. From seed size to ecosystem health: the plant trait approach. Natural Resources Canada. Canadian Forest Service. Great Lakes Forestry Centre. Sault Ste. Marie, Ontario. Frontline Express 57. 2p.

Beall, F. 2012. The effects of forest harvesting on water resources. Natural Resources Canada. Canadian Forest Service. Great Lakes Forestry Centre. Sault Ste. Marie, Ontario. Frontline Express 54. 2p.

de Groot, W. 2012. Peatland fires and carbon emissions. Natural Resources Canada. Canadian Forest Service. Great Lakes Forestry Centre, Sault Ste. Marie, Ontario. Frontline Express 50. 2p.

Filipescu, C.N.; Groot, A.; Macisaac, D.A.; Cruickshank, M.G.; Stewart, J.F. 2012. Prediction of diameter using height and crown attributes: A case study. Western Journal of Applied Forestry 27: 30-35.

Godin, A.; McLaughlin, J.W.; Webster, K.L.; Packalen, A.; Basiliko, N. 2012. Methane and methanogen community dynamics across a boreal peatland nutrient gradient. Soil Biology and Biochemistry 48: 96-105.

Holmes, S.B.; Pitt, D.G.; McIlwrick, K.A.; Hoepting, M.K. 2012. Response of bird communities to single-tree selection system harvesting in northern hardwoods: 10-12 years post-harvest. Forest Ecology and Management 271: 132-139.

Joyce, L.A.; Price, D.T.; McKenney, D.W.; Siltanen, R.M.; Papadopol, P.; Lawrence, K.; Coulson, D.P. 2011. High resolution interpolation of climate scenarios for the conterminous USA and Alaska derived from General Circulation Model simulations. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station, General Technical Report RMRS- GTR-263.

Koch, F.H.; Yemshanov, D.; Magarey, R.D.; Smith, W. D. 2012. Dispersal of invasive forest insects via recreational firewood: A quantitative analysis. Journal of Economic Entomology 105: 438-450.

Kreutzweiser, D.P. 2012. The effects of logging in riparian areas. Natural Resources Canada. Canadian Forest Service. Great Lakes Forestry Centre. Sault Ste. Marie, Ontario. Frontline Express 56. 2p.

Kreutzweiser, D.P. 2012. Forest management practices based on emulation of natural disturbances (END): implications for aquatic ecosystems. Freshwater Science 31: 222-223.

Kreutzweiser, D.P.; Sibley, P.K.; Richardson, J.S.; Gordon, A.M. 2012. Introduction and a theoretical basis for using disturbance by forest management activities to sustain aquatic ecosystems. Freshwater Science 31: 224-231.

Kyei-Pokyu, G. 2012. Biological control of emerald ash borer.. Natural Resources Canada. Canadian Forest Service, Great Lakes Forestry Centre, Sault Ste. Marie, Ontario. Frontline Express 52. 2p.

Myers. B.M.; Webster, K.L.; McLaughlin, J.W.; Basiliko, N. 2012. Microbial activity across a boreal peatland nutrient gradient: The role of fungi and bacteria. Wetlands Ecology and Management 20 (2): 77-88.

Natural Resources Canada. 2012. Forest insect and disease diagnostics. Natural Resources Canada.Canadian Forest Service. Great Lakes Forestry Centre. Sault Ste. Marie, Ontario. Frontline Express 58. 2p.

Naylor, B.J.; Mackereth, R.W.; Kreutzweiser, D.P.; Sibley, P.K. 2012. Merging END concepts with protection of fish habitat and water quality in new direction for riparian forests in Ontario: A case study of science guiding policy and practice. Freshwater Science 31: 248-257.

Parker, W.C.; Pitt, D.G.; Morneault, A.E. 2012. Influence of herbaceous and woody vegetation control on seedling microclimate, leaf gas exchange, water status, and nutrient relations of *Pinus strobus* L. seedlings planted in a shelterwood. Forest Ecology and Management 271: 104-114.

Pedlar, J.H.; McKenney, D.W.; Beaulieu, J.; Columbo, S.; McLachlan, J.S.; O'Neil, G.A. 2011. The implementation of assisted migration in Canadian forests. The Forestry Chronicle 87: 766- 777.

Sibley, P.K.; Kreutzweiser, D.P.; Naylor, B.J.; Richardson, J.S.; Gordon, A.M. 2012. Emulation of natural disturbance (END) for riparian forest management: synthesis and recommendations. Freshwater Science 31: 258-264.

Thompson, D.; Pitt, D. 2012. Forest herbicide research. Natural Resources Canada. Canadian Forest Service. Great Lakes Forestry Centre. Frontline Express 53. 2p.

Venier, L.A.; Holmes, S.B.; Pearce, J.L.; Fournier, R.E. 2012. Misleading correlations: The case of the Canada warbler and spruce budworm. The Journal of Wildlife Management 76: 294-298.

Vermunt, B.; Cuddington, K.; Sobek-Swant, S.; Crosthwaite, J.C.; Lyons, D.B.; Sinclair, B.J. 2012. Temperatures experienced by wood-boring beetles in the under-bark microclimate. Forest Ecology and Management 269: 149-157.

Wotton, M. 2012. Prescribed buring in the tallgrass prairie ecosystem. Natural Resources Canada. Canadian Forest Service. Great Lakes Forestry Centre. Sault Ste. Marie, Ontario. Frontline Express 55. 2p.

Yemshanov, D. 2012. Modelling and mapping risks as tools to better manage invasive forest pests. Natural Resources Caanda. Canadian Forest Service Great Lakes Forestry Centre, Sault Ste. Marie, Ontario. Frontline Express 51. 2p.

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