



Forest Herbicide Research

INTRODUCTION

Herbicide applications are an important silvicultural tool in the regeneration of Canada's forests. In 2009, herbicides were used to control competing vegetation on approximately 119,000 hectares of regenerating forests, largely in the provinces of Ontario, Alberta, and New Brunswick (Figure 1). Herbicides are a cost-effective, efficient and reliable tool that helps ensure plantation success. Their use is particularly important in retaining appropriate levels of conifer-dominated stands on the landscape. The Canadian forest industry relies on the judicious use of herbicides as one element of an integrated vegetation management program designed to ensure forest renewal, sustainable resource use, and to remain internationally competitive.

The Federal government is involved in a number of aspects related to herbicide registration and research. The Pest Management Regulatory Agency of Health Canada reviews and regulates all pesticide use under the Pest Control Products Act, although provincial regulatory authorities may also impose further restrictions or guidelines on use. Prior to registration and use, each compound is subject to rigorous scientific review and testing with regard to potential effects on humans or the environment (Figure 2). Natural Resources Canada – Canadian Forest Service (CFS) carries out research that addresses specific issues related to forestry, with a particular focus on potential indirect effects on wildlife species or their habitat that might be detrimental to ecological integrity. CFS researchers have also been actively engaged in discovery and assessment of other non-chemical vegetation control methods, including biological control with native fungal organisms.



Figure 1. Operation application of herbicide to a regenerating forest.



Figure 2. Experimental glyphosate trial.

GREAT LAKES FORESTRY CENTRE (GLFC) RESEARCH

The most commonly used forest herbicides in Canada over the last decade have been glyphosate-based (marketed under several different trade names) and in 2009, they accounted for more than 98% of the forest area treated. Both before and after the registration of glyphosate for use in Canadian forestry in the 1980s, GLFC scientists have been studying its fate and persistence in the environment, the potential for any deleterious effects in forest ecosystems, and improved methods for application.

Studying environmental effects

In the GLFC laboratory, state-of-the-art instrumentation is used for the extraction and analysis of compounds, which is essential in studies that examine the fate and persistence of herbicides in the environment. Laboratory and field studies have shown that glyphosate is rapidly degraded by naturally occurring micro-organisms and is therefore not persistent in soil or water. Also, it is strongly attached to organic carbon and clay particles and is thus not susceptible to leaching downward into groundwater or being washed into surface water.

Recent research has focused on assessing potential direct or indirect effects of herbicide use on the ecological integrity of forest wetlands and associated wildlife, including various amphibian species. While it is generally accepted that glyphosate does not cause acute toxicity to wildlife species, including birds, mammals, amphibians, insects or microbial organisms, public concern over the possible effects on amphibians has led to a further examination of this issue. Amphibians are a physiologically unique and ecologically important group of vertebrates that are considered to be effective indicators of forest

ecosystem health at the terrestrial/aquatic interface. GLFC scientist Dean Thompson recently completed a multi-year collaborative study that investigated the effects of glyphosate on leopard and green frogs. Results indicated that glyphosate does not pose an unacceptable risk to amphibian larvae when applied in accordance with label requirements governing use in forestry. The results of this study differed markedly from studies conducted in the United States, which concluded that glyphosate-based herbicides were toxic to amphibians, resulting in intense public interest in this issue.

Previous laboratory studies have shown that larval fish and amphibians are particularly sensitive to the surfactant POEA, which is included in many glyphosate-based end-use products to enhance the uptake of the active compound across the waxy cuticle of plants and therefore its effectiveness. Although several laboratory studies, including those by Thompson and co-workers showed toxic effects of end-use formulations containing POEA on larval amphibians, such effects were not observed under exposure levels typical of forest use scenarios. Subsequent to completion of these studies in Ontario, Thompson has been collaborating with other researchers at the University of New Brunswick in another extensive field study examining potential effects of new glyphosate-based formulations on amphibians and general wetland ecology. Results to date are similar to the earlier findings of no significant deleterious effects under environmentally relevant exposure levels. A sub-study that focussed specifically on potential effects on juvenile green frogs, showed no direct toxic effects or negative influence on size or weight of frogs directly oversprayed with the formulated product. Results from a repeat of this study are currently being analyzed as part of a multi-faceted study that is also examining the response of plants, larval amphibians, aquatic invertebrates, phytoplankton and zooplankton communities to glyphosate-based herbicides, both alone and in combination with other stressors.

Optimizing spray application methods

Thompson has also been involved in a project with colleagues in the United States and New Zealand to develop a decision support system called SprayAdvisor that optimizes targeting of aerially released herbicides and thus further enhances protection of non-target areas. The system integrates advanced technologies such as geographic information systems, global positioning, electronic-guidance, remote sensing and on-site meteorological monitoring to optimize spray applications. The system will be useful in all phases of herbicide treatment programs, including planning, operational application and post-treatment assessments. The wide variety of data input into SprayAdvisor yields site-specific predictions of herbicide deposition, efficacy and potential off-target environmental effects. Results from validation studies to date have been highly encouraging and have been used as the basis for training workshops designed to encourage the use of SprayAdvisor as a standard operational practice for herbicide applications in Canada.

CONCLUSIONS

Herbicide applications are an effective and economical method of managing competing vegetation and enhancing regeneration success, thus ensuring sustainable development of the forest resource. They are particularly critical to the successful regeneration of conifers. CFS researchers undertake extensive scientific studies, including laboratory and field investigations and modelling efforts, to ensure a full understanding of any potential deleterious effects on forest ecosystems or associated wildlife species. Such studies are often designed to address key concerns of the public. The results of these efforts contribute significantly to the weight of scientific evidence indicating that glyphosate-based herbicides, when used in accordance with all label specifications, do not pose an unacceptable risk to wildlife species or the environment.

COLLABORATORS

- Universities of Guelph, New Brunswick (St. John), West Virginia and Dartmouth College (New Hampshire)
- Incremental Forest Technologies Ltd.
- Ontario Ministry of Natural Resources
- Forest Research Partnership
- Forest Ecosystem Science Co-op
- Alberta Forest Industry Consortium
- Tembec Forest Products
- EACOM Timber Corporation
- US Dept. of Agriculture - Forest Service
- Scion Research Institute, New Zealand

RELATED PUBLICATIONS

Thompson, D.G.; Pitt, D. 2011. Frequently asked questions (FAQs) on the use of herbicides in Canadian forestry. Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre, Sault Ste. Marie, Ontario. Frontline Technical Note 112. 8 p.

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