TREE TIPS
RESEARCH SUMMARIES

Spray Advisor Decision Support System

Forestry Research Partnership Project # 160-401

The Aim

Efficient and effective regeneration are critical to the sustainable use of high value fibre from Canadian forests. Competition for light, moisture, nutrients, and space often results in growth loss during the early phases of regeneration, and as such, control of competing vegetation is required to ensure stand establishment. A number of vegetation management techniques are available and used on a regular basis by foresters in accordance with site-specific prescriptions. Among the many techniques, aerial herbicide applications are perhaps the most effective and efficient – especially in the boreal forest. Glyphosate dominates herbicide use in Canada with application to ~ 90% of the treated areas. There have long been concerns about herbicide use from public land owners, forest certification agencies, environmental groups, and industry accountants.

Aerial application of herbicide VisionMax made by Gateway Helicopters to the Intensive Forest Management demonstration site (Block 18) near Timmins, ON.

Continuous improvement in best management practices and associated technologies are required to address these concerns. Recently, significant developments in various new technologies including differential global positioning systems (DGPS), geographic information systems (GIS), electronic guidance systems, automated booms, and remote sensing have occurred, all of which have the potential to improve the accuracy of aerial herbicide applications. While all of these technologies are used to some degree, full integration in both concept and practice has generally been lacking. As part of an internationally collaborative effort to address this need, this project was undertaken to develop and validate SprayAdvisor as a decision support system capable of integrating scientific and experiential knowledge together with multiple new technologies; the goal being to optimize efficacy, cost-effectiveness, and environmental protection associated with aerial application of herbicides in Canadian forestry.

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Specific objectives for this multi-year project included:

- assessment of benefits provided by electronic guidance for enhanced uniformity of spray applications,
- assessment of the accuracy and potential use of automatic control of spray booms,
- quantitative determination of the uniformity of herbicide deposition on target,
- quantitative determination of off-target deposition and trends in deposition through spray and riparian cut-reserve buffers,
- comparative assessment of true-colour digital and near-infrared satellite image analysis as methods for defining phytotoxicity contours and quantification of post-spray efficacy,
- assessment of the potential to realize silvicultural and environmental exclusion zones within operational spray blocks.
- Overall assessment of the accuracy of SprayAdvisor predictions of on- and off- target deposition, efficacy and potential biological effects on non-target plants and animals

The Approach

Intensive monitoring of meteorological, spray application, and spatial variables controlling deposition of aerially released spray clouds have now been completed on 24 spray blocks treated with various glyphosate-based herbicide products using either fixed-wing or rotary wing aircraft. These studies have been conducted under conditions typical of operational treatment regimes in boreal regions of both eastern and western Canada, where aerial herbicide treatments are most commonly employed. Post-spray assessments of efficacy and potential off-target deposition, involving remote sensing and image analysis techniques as well as in-situ biomonitoring have also been undertaken on many of these study sites. Resultant data are now being used to calibrate and validate spatially explicit predictions of deposition, efficacy and potential off-target effects generated by the SprayAdvisor DSS system. Meteorological conditions of air temperature, relative humidity, wind speed and wind direction were monitored continuously throughout each spray session. Herbicide deposition was monitored and quantitative analysis of glyphosate deposition was conducted using a gas chromatographic technique with nitrogen-phosphorus detection. Phytotoxicity contours, defined as the visible boundary between live and dead competing vegetation were determined approximately one year after herbicide application based on digital image analysis of ortho-rectified, near-infrared satellite images.

Initial prediction of herbicide deposition levels overlain on near-infrared Ikonos satellite image for IFM demo block CS18-2.

The Tree Tip

Upon full development, validation and beta-level testing of the SprayAdvisor DSS system will provide operations foresters, aerial applicators and regulators alike with an extensive suite of modeling and spatially-explicit prediction capabilities including the following:

- on-target herbicide deposition and efficacy,
- off-target deposition and its potential effects on representative non-target plants and animals
- operational cost analyses under a wide variety of "what if" scenarios as part of operational planning, post-treatment retrospective assessment and analysis, and
- a learning tool to significantly enhance understanding of the multivariate complexities of aerial spray operations and outcomes.

As such the SprayAdvisor DSS is a tool which allows full integration of all modern technologies directly into operational practice and provides users familiar with ARC-based GIS applications a capability to assess key aspects of their spray programs *a priori* as well as providing a mechanism for integrated acquisition and archiving of resultant data. SprayAdvisor DSS is now poised to contribute significantly to enhanced planning and control of aerial herbicide applications as required for cost-effective, efficacious and environmentally acceptable control of competing vegetation and enhanced forest regeneration. It is also being extended to provide similar outcomes relative to aerial applications of insecticides as required to protect mature stands from the ravages of defoliating insect pests. Ultimately, the SprayAdvisor DSS is expected to become the critical element in best management practices for sustainable forest management and environmental protection in Canada.

The initial roll-out of SprayAdvisor DSS in Canada will occur through a specific technology transfer and training workshop scheduled for May 20-22, 2008, at the Canadian Ecology Centre in Mattawa, Ontario. A similar workshop is also being planned for 2009 in Western Canada.

The Team

Dean Thompson, Canadian Forest Service – Natural Resources Canada, Sault Ste. Marie Ontario

Harold Thistle, United Sates Forest Service, Morgantown, West Virginia

Brian Richardson, SCION, Rotorua, New Zealand.