Natural Resources Canada | Ressources naturelles Canada

Canadian Forest Service

Atlantic Forestry Centre – Making a Difference

Impact Note No. 59

Using native willows for site reclamation

Canada has 76 native willow species distributed across every region of the country. Willows are usually among the first species to appear following disturbance and can survive on sites that often prove difficult for other species.

Despite this rich species diversity and ecological importance, our native willows have received limited attention as a potential resource for land reclamation following disturbances such as mining operations. Research carried out by Dr. Alex Mosseler, Canadian Forest Service, has shown that two species, sandbar willow (*Salix interior*) and heartleaf willow (*S. eriocephala*), appear to be well adapted to highly disturbed, former coal mine sites. Sandbar willow may also be a useful species for restoring oil sands sites because it is a natural invader and colonizer of oil sands tailings in Alberta.

Most willow species can produce roots from dormant stem cuttings. A clone (plants with the same genetic makeup) can be produced by collecting several cuttings from a single plant. These clones can then be field tested to determine how they react to various environmental conditions. Researchers test how plants that are collected from different environments perform when they are grown under similar conditions (a common garden). In 2005, Dr. Mosseler established common garden experiments for willows at the Montréal Botanical Gardens (MBG).

Assessing the performance of plants from natural populations versus selected clones

Beginning in 2008, a series of common garden field experiments were established at the Salmon Harbour coal mine spoils site near Minto, New Brunswick. The site consists mainly of recently bulldozed and landscaped shale overburden. Site quality is generally poor with low organic matter, low nitrogen and acidity levels ranging from 3.6 to 6.8 pH. Dr. Mosseler used selected clones from the previous experiments at the MBG along with clones from seven native willows from Quebec and Ontario that were collected in 2008.

The survival and growth of both the selected MBG willow clones and those collected from natural populations were assessed. Dr. Mosseler determined that the MBG clones had better survival and greater biomass and produced more stems per coppice than clones collected directly from natural populations without any prior field testing. This demonstrates that selecting better clones can

Canada

rapidly improve performance, even in harsh environments. The sandbar willow and heartleaf willow survived better and produced the most above-ground biomass.

Assessing willow performance on disturbed sites

Native willows show tremendous potential for restoring highly disturbed areas such as mine sites. Soil quality on disturbed sites such as mine spoils or oil sands sites is often poor (low organic matter content, high acidity, shallow and rocky soil profile, low microbial activity, etc.). However, our native willows are well-adapted to colonizing these disturbed sites.

Sandbar willow is a natural invader and colonizer of oil sands tailings. It has a wide-spreading lateral root system that can produce a multi-stemmed colony via root suckering in a manner similar to aspen (*Populus tremuloides*). Also, the roots can reach deep into the soil in search of water, making this native North American willow very desirable for soil stabilization along watercourses, stream banks and areas prone to erosion and flooding.

In addition to differences in survival and biomass production, Dr. Mosseler noted differences in crown architecture. Some clones had a much more diffuse canopy, which could provide a protective canopy or nurse crop in forest restoration activities.

Dr. Mosseler also assessed willow performance in very acidic soil, which is often problematic for plant growth. Under extremely low pH, potentially toxic heavy metals in the soil become more soluble for uptake by plants and can cause toxic conditions for plants.

Willows were established on a highly acidic clay site (pH = 3.6) and on an adjacent neutral shale overburden site (pH = 6.8). Foliar analysis showed that willows grown on the acidic clay site removed 1.5 to 5 times the amount of magnesium, manganese, iron, aluminum and sulfur than those grown on the neutral pH shale overburden site. Despite the higher plant uptake of metals on the acidic site, the willows grew reasonably well and showed little evidence of toxicity. The ability of willows to remove these metals from the soil varied among species and clones.

Native willows show tremendous potential for restoring disturbed sites. Dr. Mosseler's research shows that we can rapidly improve the performance (survival, biomass production, tolerance to low pH, ability to remove heavy metals, etc.) of willow on disturbed sites through appropriate clonal selection.

Willow survivability and growth vary among clones and sites, which indicate a strong genetic by environment interaction. This finding provides an opportunity to work with our native willow species to develop clones that are suitable for specific purposes. It also suggests that we should seriously consider using native willows for restoring disturbed areas such as mine spoils or oil sands sites.

For more information, contact:

Dr. Alex Mosseler

Research Scientist
Natural Resources Canada
Canadian Forest Service, Atlantic Forestry Centre
P.O. Box 4000
Fredericton, NB E3B 5P7

Tel.: 506-452-3500
Email: Alex.Mosseler@Canada.ca

Impact Note No. 59
Cat. No. Fo103-3/59-2015E-PDF (Online)
ISBN 978-0-660-03229-0

Aussi disponible en français sous le titre : Utilisation de saules indigènes pour la mise en valeur des sites