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Canadian Forest Service

Atlantic Forestry Centre – Making a Difference

Impact Note No. 60

Improving the survival and growth of conifer seedlings in a changing climate

Changes in climate are affecting the growth of trees. Warmer temperatures earlier in spring and later in autumn are lengthening the growing season. However, extreme weather events such as droughts are also increasing in frequency and duration. As our climate becomes drier, nurseries are looking for ways to improve seedling quality to increase survival after planting. An innovative approach is using a commercially available seaweed extract to improve root growth in conifer seedlings. Greater root growth may provide seedlings with a competitive advantage as we move toward a drier climate.

Dr. Joanne MacDonald

Planting stock is particularly sensitive to a warmer and drier climate because seedlings go quickly from freezer storage to field conditions that are sometimes very challenging. Following a particularly dry growing season in the southern interior of British Columbia, Dr. Joanne MacDonald, a research scientist with the Canadian Forest Service in Fredericton, New Brunswick, inquired about the survival of planted seedlings. MacDonald learned that seedling survival had been affected by the drought.

Seaweed extracts

Using seaweed to improve plant growth is not new. For centuries, farmers in coastal areas throughout the world have used storm-cast and fermented seaweeds as a soil conditioner. In the 1950s, commercial seaweed extracts were developed. These products have undergone rigorous scientific investigations, and positive responses have been reported in various agricultural crops. Dr. MacDonald's interest in seaweed extracts grew upon learning that they promote root development and increase resistance to water stress.

MacDonald selected a seaweed extract of *Ascophyllum nodosum* – a brown alga commonly found in the intertidal zone of the North Atlantic. There are several *Ascophyllum nodosum* extracts (ANE) on the market. She chose a company that uses a manufacturing process that was initially developed by the National Research Council of Canada. The company harvests the seaweed in a sustainable manner, which is important for forest certification. The product is registered by the Canadian Food Inspection Agency to use in forest nurseries.

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Seedling trial

MacDonald designed an experiment to determine if, and at what rate, ANE would increase root growth in lodgepole pine (*Pinus contorta* var. *latifolia*) seedlings. Seeds were sown in containers and grown according to standard nursery practices for 19 weeks. In early September, various rates of ANE in finisher fertilizer were applied to the seedlings. Finisher fertilizer without ANE served as the control.

In December, the seedlings were lifted, protected against desiccation, and freezer stored. The following spring, the seedlings were potted and grown in a greenhouse for 21 days. Then, all new roots measuring >1 cm in length were cut from the peat plug and categorized as short (<5 cm) or long (>5 cm) roots.

Results

The application rate of ANE had a statistically significant effect on the number of new roots. The optimal rate increased the number of short roots by 24 percent and the number of long roots by 42 percent compared to the control seedlings (no ANE). The length of all new roots per plug was not measured but was observed to be longer in the ANE-treated seedlings than in the control seedlings.

Cost of applying ANE

Nurseries have to consider the added cost of applying ANE. As a plant biostimulant, ANE stimulates growth at very low concentrations. The cost of ANE to elicit the observed rooting response was 0.07¢ per tree, or 70¢ per thousand seedlings.

Relevance to the sector

In British Columbia, a commercial nursery is exploring the commercialization of the ANE protocol. MacDonald is the scientific and technical advisor for the project, which is funded by the National Research Council through its Industrial Research Assistance Program.

In Newfoundland and Labrador, the Wooddale Provincial Tree Nursery is running preliminary trials under MacDonald's guidance.

Ascophyllum nodosum

New root growth of seedlings not treated with ANE (left) and treated with ANE (right).

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MacDonald, J.E., Hacking, J., Weng, Y., and Norrie, J. 2012. Root growth of containerized lodgepole pine seedlings in response to Ascophyllum nodosum extract application during nursery culture. Canadian Journal of Plant Science 92: 1207–1212.

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