Natural Resources Canada
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CWFC Facts 011

Canadian Wood Fibre Centre

Fibre Facts

Waste Utilization in Wood Biomass Production

Researchers with the Canadian Wood Fibre Centre (CWFC), Natural Resources Canada, have been studying the effects of applying municipal wastewater and biosolids on the fibre production of woody crops. This is an alternative to traditional waste treatment. They are looking at how these systems can utilize organic waste in the production of wood biomass from high-density willow and hybrid poplar plantations. Analysis of the full production process will enable municipalities to assess the system's suitability for waste treatment and fibre production as well as options available to them in the full management cycle and end use of the crop.

CWFC researchers are testing and demonstrating wastewater and biosolids application to both short rotation intensive culture (SRIC) and afforestation systems. These systems require a high level of management, and a predetermined and precise row spacing to optimize biomass yield and stem volume, respectively, and to facilitate weed control.

Short rotation intensive culture woody crops are established at densities of 15 000–20 000 stems per hectare (sph) in a two-row bed pattern. Crops are harvested on a three-year rotation with a full SRIC cycle encompassing seven to eight rotations or 21–24 years on the same root system. The SRIC crops research focuses mostly on willow. Fast growth, ease of propagation, ability to be coppiced, high water use, and potential for genetic improvement make willow ideally suited for biomass production and treatment of wastewater and biosolids.

For the hybrid poplar afforestation system, planting densities range from 900 to 2000 sph. The trees are used for traditional forest product manufacture. Hybrid poplar planted on the research site at Clairmont, Alberta, at 950 sph are projected to be harvested approximately 5–6 years sooner with irrigation than the expected 18–25-year rotation without irrigation. The harvested material will be used at the Ainsworth Engineered OSB plant in neighboring Grande Prairie, Alberta.

CWFC's researcher Richard Krygier started this project in the spring of 2006 with the establishment of western Canada's first municipal wastewater-irrigated SRIC willow and poplar plantation at Whitecourt, Alberta. He wanted to determine if the proven European technology for wastewater and biosolids application to SRIC crops would work as well to increase woody biomass production in Alberta. Concurrently, the Canadian Council of Ministers of the Environment was developing new stricter standards for the discharge of municipal wastewater. Interest in this concept grew as municipalities looked at creative and cost effective ways of not

(Top) Irrigation pump platform floating in sewage lagoon at Beaverlodge, Alberta, fall 2011. (Right) Willow harvesting at wastewater treatment plant, Whitecourt, Alberta, December 2011.

Willow plantation at Beaverlodge, Alberta, after first full season of irrigation, fall 2011.

only meeting the new standards but of reducing their environmental footprint (e.g., bioenergy) and developing new economic opportunities.

To further the research and demonstrate the concept, the CWFC received funding from Alberta Innovates Bio Solutions. Martin Blank, also of the CWFC, and Richard Krygier established five additional research locations by the end of 2011. Approximately 20 organizations from government, industry, private companies, and academia became involved in the project.

Of the six research sites throughout central and northern Alberta, four are dedicated to irrigation with wastewater. Subsurface drip irrigation is used on three sites, and one site will use a surface irrigation technology (installation 2012) commonly used in Europe (e.g., Ireland and Sweden) on SRIC crops. The use of different irrigation systems will enable the assessment of each method and provide options to address concerns and constraints specific to interested municipalities (e.g., potential for human contact, cost). The research will determine the irrigation rates for the crop, and their effect on biomass production and the environment.

Biosolids, the non-liquid portion of municipal sewage, will be applied to the two remaining sites. Biosolids are applied by direct injection into the soil or by surface application followed by tilling. By varying the biosolids application rate of nitrogen content from 200 kg to 400 kg N/ha, the effect on biomass production and utilization of waste can be assessed.

Provincial guidelines and regulations for application of wastewater and biosolids to agronomic crops have been set to address agricultural and environmental concerns. Krygier and Blank hope to assist regulators in making informed decisions regarding this application to woody crops by monitoring environmental parameters, such as soil nutrient and salt concentrations, soil and ground water, foliar nutrients and soil respiration.

Harvesting and handling of the biomass is a key component in crop management. In December 2011, three types of harvesting equipment, representing two harvesting methods and two scales of operations, were demonstrated at the SRIC plantation in Whitecourt. CWFC personnel and the Forest Operations staff of FPInnovations assessed each piece of equipment for productivity and biomass recovery rates. The results from this study will help executives and others make management decisions for optimal end-product usage. The team will also be assessing the effectiveness of an agricultural system to dry the wood chips produced from this process and will compare results to round bales of willow.

The CWFC is working with its partners and collaborators to provide rural municipalities with not only an economic and environmentally friendly option for treatment of organic wastes but with a means of producing wood fibre. This wood fibre will contribute to community diversification and stability by providing a feed stock for bioenergy production in addition to fibre for supporting existing or developing new industries.

Researchers Richard Krygier (left) and Martin Blank (right).