From past energy willows to new biomass studies and novel products – a Finnish pilot study

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Novel bio-economy approaches require more and faster production of lignocellulosic biomass and a better tailored use of it for higher added-value products. Structural and chemical properties of willows determine their suitability for specific higher valued products and design applications, such as designed biochar, high-quality bio-composites or pharmaceutical applications.

Bioenergy projects in the 1980's in Finland provided knowledge about the hybridization, cultivation and management of short rotation coppice (SRC) willows for energy purposes. This knowledge can now be used for producing biomass for applications of higher added-value. However, there is a lack of knowledge about the genetic variation in quality traits of wood biomass between and within willow species as well as about the interlinkages between the raw-material quality of SRC willows and properties and functionalities of novel end-products.

For a pilot study, five hybrid willow clones originating from past energy willow hybridization program, were selected from a clone archive located in south-western Finland. These clones were hybrids of *Salix schwerinii*, pollinated by: *S.* cv. Aquatica, *S. myrsinifolia*, *S. phylicifolia*, and *S. viminalis* x *S. xdasyclados*. One 5-year-old sprout was harvested from three stools of each clone, and 10-cm-long samples were cut from the lower and upper part of the sprout in January 2018. Of the sampled stools, the number of sprouts was counted and the dominant height and diameter of the five tallest sprouts were measured. For the analysis of clonal and within-sprout variation in fiber properties and wood structural characteristics, smaller wood specimens were prepared. Fiber properties (e.g., length, width, coarseness, and length distributions) were measured from macerated specimens by using Valmet Fibre Image Analyzer (FS5). For the analysis of wood porosity (defining water retention properties of biochar produced later in the project), other specimens were over-dried and analyzed in 3D by using X-ray microtomography at 1-µm -resolution.

Preliminary results will be presented on the clonal and within-sprout variation in fiber properties, 3D pore space structures of wood, as well as of the growth and coppicing vigor of the clones.

Keywords: biochar, biocomposite, fibers, pore structure, *Salix*, 3D imaging, wood structure

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