Clonal variation in growth and productivity of poplar and willow in a bio-energy plantation (POPFULL)

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The POPFULL research project aims at (i) providing a full accounting of the greenhouse gas balance, (ii) the quantification of energy efficiency and (iii) an analysis of the economic balance of a short-rotation coppice (SRC) culture with poplar and willow trees. The ultimate goal is to examine the potential of SRC cultures to reduce atmospheric CO_2-concentrations in Europe, through fossil fuel substitution, and to mitigate climate change. Within the context of POPFULL, clonal variation in production-determining characteristics is studied, in relation to biomass yield for energy production.

A 19 ha high-density SRC plantation with fast-growing poplar and willow clones was established on a farmland in Flanders (Belgium) at the beginning of April 2010. Twelve poplar (*Populus*) and three willow (*Salix*) clones were used, representing different species and interspecific hybrids of *P. nigra*, *P. trichocarpa*, *P. deltoides*, and *P. maximowiczii* for poplar and *S. alba*, *S. dasyclados*, *S. schwerinii* and *S. viminalis* for willow. After soil preparation by ploughing and tilling, 25 cm long dormant and unrooted cuttings were planted, that had been soaked in water for 24 h. They were planted following the Swedish double-row system with alternating inter-row distances of 0.75 m and 1.5 m and a distance of 1 m in the row. This corresponds to a planting density of 8900 cuttings per hectare. The planting was performed with a converted agricultural leek planting machine. The plantation is designed in large replicated clonal blocks, which cover different types of previous land use. The spatial pattern of clones, that has been mapped, is used for a correct interpretation of the continuously measured greenhouse gas fluxes above the plantation. Assessment of mortality and initial growth has been executed, indicating rooting and establishment capacity of different clones in the given environmental conditions.

Both structural and ecophysiological growth characteristics are examined for a period of 2 + 2 years. Phenological patterns, leaf area index (LAI) and crown architecture, which represent the total photosynthetic area, will be measured in detail including seasonal and annual variation. An ecophysiological characterization of photosynthesis will be performed at the leaf level. Structural measurements provide height and diameter data, used to estimate biomass yield through allometric relations. Significant rust infection and/or pests will be scored to evaluate clonal variation in tolerance level. After the first harvest, coppice ability of the different clones will be quantified by monitoring mortality, number of shoots per stump and self-thinning. This research receives funding from the European Research Council under the European Community's Seventh Framework Programme (FP7/2007-2013), ERC grant agreement nr. 233366 (POPFULL).

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