Growth and productivity responses of willow and poplar in SRIC for treatment of aquaculture effluents in southern Quebec: preliminary results

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Following recent environmental applications of willow and poplar for remediation of urban wastewaters, SRIC plantations have also been proposed as a means for treating effluents of aquaculture plants. However, compared with other wastewaters (i.e. urban sewages), effluents from aquaculture on average present low concentrations of both nitrogen and phosphorus. This is mainly due to the fact that water flow rate in these plans is kept high to reduce free ammonia concentrations originating in excreta and undigested fodder. Therefore, when irrigated with such effluents, plant growth may be affected by related nutrient shortage or partially flooded soil conditions. Moreover, the high water flow may lead to a leaching of nutrients from soil and consequent loss of fertility. The aim of this study was to evaluate the performance of willow and poplar in SRIC grown under such conditions in southern Quebec (Canada). In this poster we present the preliminary results of the project.

The plantation was established in spring 2004 close to a fish farm, on a surface of about 0.25 ha. In May 2004, 20 cm long cuttings of *Salix viminalis* and *Populus maximowiczii x P. nigra* (NM5) were planted at a density of 20.000 plants per hectare in a single row. At the end of the second growing season, all the plants were cut down in order to ensure good establishment. In spring 2006, the experimental field was split into four main treatments per species as follows: fertilised-irrigated (F-I), fertilised-non irrigated (F-NI); non fertilised-irrigated (NF-I), non fertilised-non irrigated (NF-NI). Sprinkler irrigation started on July 1st and ended on September 30th. About 42 mm of effluent was provided daily for a total of about 3750 mm throughout the growing season. Fertilisation was performed by applying 200 kg ha^{-1} of nitrogen (urea) once in spring. The height of the main stem, its basal diameter, the number of stems per stool as well as the oven dry biomass were evaluated. Leaf samples were collected in July from well-developed leaves 20 cm from the top of the main stem for chemical analysis and SLW measurements. Analyses of variance followed by multiple comparisons of means according to Tukey's method were performed using SAS software, to determine significant differences among the various treatments.

Most growth parameters, including biomass yield, were negatively affected by high irrigation treatment (I). Fertilisation (F) did not seem to affect most growth parameters (i.e. height and diameter) in either species. Fertilised willow (F), as compared to unfertilised (NF), reached a higher level only in terms of biomass yield (respectively 4.3 and 1.9 t ha^{-1}). Poplar biomass yield, which ranged from 2.5 to 3.4 t ha^{-1}, showed no change due to fertilisation. This is probably due to the fact that nutrient requirements were generally satisfied in all blocks, a supposition also supported by the fact that N level in leaves and stems was almost constant in all treatments. This also suggests that willow is likely more sensitive than poplar to fertilisation. In terms of nutrient removal, neither species showed significant differences. However, within the same treatment, willow presented, on average, a slightly higher capability of retaining N than poplar. In F-I treatment, willow was able to uptake 13% of N supplied, poplar only 10%. The main differences were recorded in F-NI treatment, where willow could uptake 62% of N, poplar only 46%. Only in the NF-I treatment did poplar show higher N uptake than willow, respectively 36% and 32 %.

In conclusion, the main results obtained from this trial are as follows. Water volumes involved in this trial likely exceeded water requirements of both species. N-content in both leaves and stem was fairly constant in all treatments and did not differ from other previously reported data for the same species. Therefore, reduced biomass yield is likely due to excess water, which probably created a flood environment in which plants could not develop normally. A more calibrated irrigation will probably allow for better results in terms of growth and productivity. Fertilisation might, in some cases, positively affect growth and productivity. In particular, compared with poplar, willow seemed to take more advantage of N application. Both species seemed to show a good response in terms of N-uptake, although poplar in some cases presented the greatest ability to remove N.

Keywords: *Willow; Poplar; SRIC; Aquaculture; Phytoremediation.*