Application of wastewater from municipal wastewater treatment works to SRC willow and poplar

Alistair McCracken, Paul Moore & Astrid Werner
Applied Plant Science Division, Agri-Food & Biosciences Institute, Newforge Lane, Belfast BT9 5PX, N. Ireland, UK.
alistair.mccracken@afbini.gov.uk

Short Rotation Coppice (SRC) willow has the ability to utilise large volumes of water and can also accumulate nitrogen, certain heavy metals and to a much lesser extent, phosphorous. It is therefore a potentially useful candidate for the biofiltration of wastewater streams including effluent from municipal water treatment works. The Water Treatment Works (WTW) at Culmore, Londonderry, Northern Ireland, is a state of the art WTW serving the city of Londonderry, which has a population of approximately 105,000. Working in collaboration with the NI Water Service, primary sewage effluent is drawn from a well within Culmore WTW and piped to an experimental site approximately 500m away. The effluent is trickle irrigated onto replicate plots of poplar (Hassendens and Hoogworst), willow (*Salix* spp.) mixtures plots (comprising seven *Salix* spp. varieties planted as random short runs – 'Tora', 'Stott', 'Beagle', 'Olaf', 'Resolution', 'Endeavour' and 'Terra Nova') and plots of grass. Irrigation commenced in September 2006 when the plants had been growing for two complete seasons. The rate of application was determined by nitrogen loading – in year 1 it was applied at an approximate level of 200Kg ha^{-1} and in subsequent years the amount of N applied will be doubled. The idea of the trial is to operate the site to 'breaking point' in order to determine where the top limit of nitrogen assimilation may be for these types of system. Effluent application started as the plants were approaching senescence and continued until December 2006 when the irrigation was stopped, due to heavy rain and water-logged soils. Soil water is collected at two-weekly intervals using soil-water sampling probes. Ground water is collected at monthly intervals from each of five deep boreholes positioned around the plantation both upstream and downstream of the naturally drainage direction. Soil was sampled annually. All samples were analysed for total nitrogen (TON), total phosphate (TOP), and a range of minerals and trace elements including aluminium, boron, calcium, cadmium, cobalt, copper, iron, potassium, magnesium, manganese, molybdenum, lead, selenium and zinc. The effluent had a pH of around 6.9 and a BOD ranging from 2 to 331 over a twelve month period. TON ranged from 2 – 40 mg l^{-1} and TOP from 0.2 – 9.0 mg l^{-1}. With the exception of calcium, potassium and manganese all of the other elements were present in the effluent only as traces. The E_c of the effluent was around 2000 uS cm^{-1}.

To date (March 2007) no significant differences have been detected in nutrient levels in soil water between irrigated and non-irrigated plots of any of the crops. In irrigated plots of poplar TON in the soil water was elevated compared to grass and willow, from October to December and in the non-irrigated plots from September to December. TON from the grass and willow plots remained consistently low throughout the sample period. In none of the boreholes was there any indication that nutrients or metals were being washed into the ground water. E_c was consistently low at every sample date, even following heavy rain.

Application of effluent will re-commence in April 2007 at a significantly higher rate and monitoring will continue at the same level to attempt to determine at what point the biofiltration system fails