Screening and selection of willow clones for growth on Solvay process waste

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Syracuse, New York was the home of the first and largest industrial plant in the United States for the production of soda ash (sodium carbonate) from abundant local sources of salt (sodium chloride) and limestone (calcium carbonate) using the Solvay process. This plant operated from 1884 to 1986, generating 300 tons of soda ash per day. The by-product waste, mostly calcium chloride, was pumped as a slurry into 20-meter-high walled waste beds near the plant. Today, those waste beds occupy ~200 hectares adjacent to Onondaga Lake. Over the past century, calcium and chloride has leached from the waste beds into the lake disturbing its ecology. This project aims to establish a vegetative cap on the Solvay waste beds consisting of fast-growing shrub willows that will intercept and transpire precipitation, thus reducing or eliminating the leaching of salts into the lake. A successful shrub willow vegetative cap will be far less expensive and more aesthetically attractive than a traditional geomembrane engineered cap, and cultivation of shrub willow on the waste beds can generate biomass for bioenergy.

Two major challenges to successful establishment of a vigorous shrub willow plantation on the Solvay waste beds are: identification of inexpensive soil amendments that can be applied to improve the properties of this substrate as a medium for plant growth and to select particular clones that grow well on this medium and maintain high rates of transpiration to meet the aim of hydrologic control. Unamended Solvay waste has a typical pH of 11, with low levels of nitrogen and organic carbon and high levels of chloride. On the older waste beds, vegetation has naturally become established, including *Populus deltoides*, *Salix purpurea*, *S. bebbiana*, and *S. eriocephala*, however portions of the newest waste bed do not support any vegetation. In a previous project two decades ago, a small portion of one waste bed was amended with biosolids from a wastewater treatment plant. Soil was taken from this amended area for initial screening comparisons with unamended Solvay waste.

In 1994, a long-term program for genetic improvement of shrub willow was established at SUNY-ESF and has generated a number of fast-growing clones through controlled breeding. Cuttings from 38 clones were planted in Deepot tubes and screened for their ability to grow in unamended Solvay waste, soil from the amended portion of the waste bed, and in a commercial potting mix with sand. After 10 weeks in a glasshouse, there was significantly lower overall mean survival on unamended Solvay waste (75%) than on amended waste (95%) or potting mix (96%). Overall mean shoot dry weight was significantly higher for plants grown on amended waste than on potting mix, which was significantly higher than on unamended waste. Subsequently, three of the best-performing clones were grown in 40-liter pots containing unamended Solvay waste or waste mixed 1:1 with fermentation waste from a brewery, fermentation waste from a pharmaceutical plant, and municipal biosolids. As with the tubes, aboveground growth in pots was significantly greater in amended waste than in pure waste. A field trial with 10 clones established using 25-cm and 50-cm cuttings on the previously amended portion of the waste bed has performed significantly better over two growing seasons than 13 clones planted in unamended waste. A third field trial is currently being established to compare amendment with brewery waste, city leaf and lawn compost, and municipal biosolids.