

## Carbon Sequestration In Short Rotation Forestry (SRF) And Traditional Poplar Plantation: The JRC Kyoto Experiment.

Terenzio Zenone<sup>1-2</sup> Mirco Migliavacca<sup>4</sup> Leonardo Montagnani<sup>3</sup> Guenther Seufert<sup>1</sup> and Riccardo Valentini<sup>2</sup>

<sup>1</sup>European Commission. DG Joint Research Centre Institute for Environment and Sustainability Climate Change Unit.

<sup>2</sup>Department of Forest Environment and Resource University of Tuscia Viterbo.

<sup>3</sup>Autonomous Province of Bolzano, Forest Service Agency of Environment. Bolzano Italy.

<sup>4</sup>Remote Sensing of Environmental Dynamics Lab. – University of Milano-Bicocca, Department of Environmental Sciences (DISAT).

Corresponding author: Terenzio Zenone. Phone +39 0332 785870 fax +39 0332 785022 E-mail address [terenzio.zenone@jrc.it](mailto:terenzio.zenone@jrc.it)

In recent years, the increasing funding of non-food crops provided by the Community Agricultural Policy (CP) has brought about a series of changes in the traditional land use. In this light, considering that Short Rotation Forestry (SRF) could allow Italy to increase its quota of renewable energy production, several Italian Regions, where biomass thermoelectric power plants are under construction, have included in their Programme for Rural Development (PRD) a series of financial incentives to support the establishment and maintenance of SRF plantations. For these reason, SRF for energy purposes is rapidly expanding in Italy. In order to evaluate the carbon sequestration in traditional plantation and Short Rotation Forestry (SRF) of poplar, we measure the CO<sub>2</sub> exchange between the atmosphere and canopy using eddy correlation (EC) technique during the years 2002-2005. EC allows to determinate the Net Ecosystem Production (NEP) in terms of carbon stored by the ecosystem. The study areas are located in the northwest of Italy inside the Basin of Ticino river: the poplar plantation (*Populus x euramericana* clones I-214 spacing 6 x 6 m density 270 plants ha<sup>-1</sup>) occupies an area of 120 ha. The SRF (*P. generosa* X *P. nigra* clone Pegaso) occupies an area of 80 ha: trees were planted in March 2004 using 1-year-old seedlings in a double row design with a spacing of 2.8 x 0.75 x 0.45 m corresponding to a density of 12.500 plants/ha. The three years observation in poplar plantations shows that the carbon uptake was stronger in 2003 than in 2002 for a period ranging from bud break up to around DOY 160 (early June). Afterwards, the 2003 Net Ecosystem exchange (NEE) was severely reduced. This trend may reflect the precipitation trends of the year 2003 that were comparable to year 2002 until April while, from May onwards, precipitation was much lower in 2003. The total annual sequestration has been estimated as 11.2 and 27.5 t CO<sub>2</sub> ha<sup>-1</sup>, respectively for the first and second growing season. In addition, in order to calculate an overall GHG budget for the examined SRF plantation, CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from agriculture machinery use (ploughing, harrowing, planting, harvest, irrigation, fertiliser and pesticides spearing) were estimated according to IPCC methodology. The resulting annual GHG emission, in terms of tons of CO<sub>2</sub> equivalent ha<sup>-1</sup>, has been estimated in 1.03 and 0.59 for the first and second growing season, respectively. To further extend the GHG budget analysis, we modelled the GHG emissions/absorptions for 10 years in SRF and in a conventional, non-coppiced, poplar plantation. Based on data obtained from experimental experience and from literature, two level of productivity were hypothesized based on the level of potential productivity and intensity of the cultural practices: high (H) and low (L) inputs. The resulting CO<sub>2</sub> uptake has been calculated in 130 (L) – 183 (H) t CO<sub>2</sub> ha<sup>-1</sup> for the poplar plantation and 134 (L) – 235 (H) t CO<sub>2</sub> ha<sup>-1</sup> for SRF. On the other hand, the CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from agricultural treatments and pesticide/fertilizer production resulted to 7.7 (L) – 11.5 (H) t of CO<sub>2</sub> equivalent for poplar plantation and 9.2 (L) – 23.4 (H) for SRF. Overall, these results indicate a very good GHG balance for both the cultivations and the different scenarios analyzed.