ELS2014 –The Earth Living Skin: Soil, Life and Climate Changes
EGU – SSS Conference
Bari | Italy | 22 – 25 September 2014
ELS2014-64-1

Carbon emissions from perennial energy crops: Tall Grasses or Short Rotation Coppice, is that the question?

Francesco Agostini, Salvador Girbau, and Goetz Richter
Department of Sustainable Soils and Grassland Systems, Rothamsted Research, Harpenden, AL5 2JQ, UK

Perennial tall grass (PTG) and short rotation woody crop (SRWC) are the most promising crop systems for the production of 2nd generation biofuels. SRWC is seen as more attractive because of its lower competition with forage or arable production. Further, the combustion of woody biomass emits less reactive N into the atmosphere than fibre cellulose biomass from PTG. However, the two systems should be primarily compared on the basis of carbon sequestration into the soil and CO_2 emission in the atmosphere.

Here, we explored the carbon balance components under Miscanthus x giganteus and Short Rotation Coppice (SRC) willow (Salix viminalis) in England, using expanded versions of RothC and DayCENT, which simulate soil organic carbon (SOC) dynamics. We simulate two 14-year scenarios of SOC sequestration and emission setting the C residue inputs from respective litter and belowground biomass deposition and decomposition rates taken from the literature.

The two models (RothCE and DayCENTE) showed a similar trend in the C dynamics under Miscanthus and willow. Overall, RothCE simulated relative higher CO_2 emission than DayCENTE. Both models, however, simulated increasingly higher CO_2 emissions from willow compared to Miscanthus. After eight years this difference of simulated emissions had increased to 23% (RothCE) and 12% (DayCENTE). The higher CO_2 emission from willow compared to Miscanthus corresponded to a slightly higher SOC accumulation during the first eight years. However, from then onward the difference in SOC decreased until the 14th year to less than 1%. By that time the simulated cumulative CO_2 emission from SRC was between 16-20% higher than from Miscanthus. This is mainly driven by the turnover of fine roots under willow, which is approximately 17 times faster than under Miscanthus.

The modelling exercise suggests that the initial C storage simulated over the first eight years under willow does not compensate for its much higher C emission, at least in 14 years. Longer simulations (20 years) calibrated through field C measurement will provide a more accurate evaluation.

Keywords
bioenergy, Miscanthus, Salix, SOC, GHG, carbon turnover models.