Geophysical Research Abstracts
Vol. 15, EGU2013-1920, 2013
EGU General Assembly 2013


# Longevity of contributions to SOC stocks from roots and aboveground plant litter below a *Miscanthus* plantation

Andrew Robertson (1), Pete Smith (2), Christian Davies (3), Emily Bottoms (1), and Niall McNamara (1)

(1) Centre for Ecology & Hydrology, Lancaster Environment Centre, Library Avenue, Bailrigg, Lancaster, LA1 4AP, United Kingdom (andber58@ceh.ac.uk), (2) Institute of Biological and Environmental Sciences, School of Biological Sciences, University of Aberdeen, 23 St Machar Drive, Aberdeen, AB24 3UU, Scotland, United Kingdom, (3) Shell Global Solutions (UK), Shell Technology Centre Thornton, P. O. Box 1, Chester, CH1 3SH, United Kingdom

*Miscanthus* is a lignocellulosic crop that uses the Hatch-Slack (C4) photosynthetic pathway as opposed to most C3 vegetation native to the UK. *Miscanthus* can be grown for a number of practical end-uses but recently interest has increased in its viability as a bioenergy crop; both providing a renewable source of energy and helping to limit climate change by improving the carbon (C) budgets associated with energy generation. Recent studies have shown that *Miscanthus* plantations may increase stocks of soil organic carbon (SOC), however the longevity and origin of this 'new' SOC must be assessed. Consequently, we combined an input manipulation experiment with physio-chemical soil fractionation to quantify new SOC and $CO_2$ emissions from *Miscanthus* roots, decomposing plant litter and soil individually. Further, fractionation of SOC from the top 30 cm gave insight into the longevity of that SOC.

In January 2009 twenty-five 2 $m^2$ plots were set up in a three-year old 11 hectare *Miscanthus* plantation in Lincolnshire, UK; with five replicates of five treatments. These treatments varied plant input to the soil by way of controlled exclusion techniques. Treatments excluded roots only ("No Roots"), surface litter only ("No Litter"), both roots and surface litter ("No Roots or Litter") or had double the litter amount added to the soil surface ("Double Litter"). A fifth treatment was a control with undisturbed roots and an average amount of litter added. Monthly measurements of $CO_2$ emissions were taken at the soil surface from each treatment between March 2009 and March 2013, and soil C from the top 30 cm was monitored in all plots over the same period. *Miscanthus*-derived SOC was determined using the isotopic discrimination between C4 plant matter and C3 soil, and soil fractionation was then used to establish the longevity of that *Miscanthus*-derived SOC.

Ongoing results for $CO_2$ emissions indicate a strong seasonal variation; litter decomposition forms a large portion of the $CO_2$ emissions in winter and spring whereas root respiration dominates the summer and autumn fluxes. Additionally, the "No Roots or Litter" and "No Litter" treatments have significantly less *Miscanthus*-derived C and therefore significantly less $CO_2$ emitted from decomposing 'new' C. Results from soil fractionation concur with these findings and also suggest that most *Miscanthus*-derived SOC has fairly short mean residence times within the soil.

We hypothesised that the high C input treatments would stimulate large outputs but also increase soil C stocks. However, whilst $CO_2$ efflux varies significantly between treatments, results from the first two years of the experiment do not suggest that any increase in SOC is significant. Four years of continuous monitoring, chemical and physical soil fractionation and ecosystem C cycle modelling will allow a more comprehensive analysis of the longevity of *Miscanthus*-derived SOC and estimation of SOC stock change with time and plant inputs.