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Changes in soil carbon, (CO_2 respiration), and respective isotopic signatures after Miscanthus removal

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The removal of perennial bioenergy crops, such as *Miscanthus*, has rarely been studied although it is an important form of land-use change. *Miscanthus* is a C4 plant, and the carbon (C) it has deposited over its ∼20 years of growth will have a different isotopic signature ($^{12}/^{13}$C) compared to a C3 plant. By studying the isotopic composition of the soil C before and after harvest and comparing it with an adjacent field predominately cultivated with C3 crops, we could identify the proportion of C stored and released to the atmosphere by newly sequestered and old carbon. This information is important for carbon models and life cycle analyses.

In this project harvest related changes and isotopic composition of C in the soil and CO_2 respired were measured during a removal experiment in June 2011 from a *Miscanthus* field cultivated since 1991 in Grignon (France). The plants were removed using a 3-step method involving grinding of above-ground vegetation, glyphosate application and tillage. Thereafter, two replicate plots were converted into a rotation of annual crops and two plots had *Miscanthus* removed with no soil disturbance, followed by bare soil (set-aside). Additionally, one plot was left as control with continued *Miscanthus* cultivation and an adjacent field was used as a control for annual arable crops. Samples were taken before and after the removal and following each management/re-cultivation operation. A year later the site was revisited and changes in the isotopic composition of soil carbon and respired CO_2 measured again.

Compared to the annual food crops, a significant ($p>0.95$) increase in soil organic C (amounting to 13 t C ha^{-1}) was observed under the *Miscanthus* plot, but only in the topsoil layer. This was likely due to an accumulation of plant litter on the soil surface, made possible by the absence of tillage. This also resulted in a large accumulation of dead rhizome biomass in the topsoil layer (estimated at 22 t DM ha^{-1}). There was also a significant difference in the isotopic composition of the total soil C under *Miscanthus* compared with adjacent annual arable crops in all three measured layers (0-5 cm, 5-10 cm and 10-20 cm). In the year of the *Miscanthus* removal total C in the soil under *Miscanthus* ranged from 4.9% in the top layer to 3.9% in the lower layers with δ^{13}C values of -16.3 to -17.8 while soil C under the adjacent arable crop ranged from 1.6 to 2% with δ^{13}C values of around -23.2. A year later the soil under continued *Miscanthus* cultivation had 4.2% C in the top layer to 3.2 in the lower layers with δ^{13}C values from -15.4 to -17.2. Removal plots now under cultivation or left bare still had similar total C and δ^{13}C values while the adjacent arable plots had lower total C and δ^{13}C values as in the previous year. However, measurements in the following years will be important to assess the change or rate of change of soil C in the field converted from *Miscanthus* to annual arable food crops.