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Partitioning belowground CO_2 emissions for a *Miscanthus* plantation in Lincolnshire, UK

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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 reducing carbon (C) emissions associated with energy generation. Recent studies have shown that *Miscanthus* plantations may increase stocks of soil organic carbon (SOC), however full greenhouse gas (GHG) budgets must be calculated. Consequently, we monitored emissions of N_2O, CH_4 and CO_2 from *Miscanthus* roots, decomposing plant litter and soil individually to quantify and partition these emissions and better understand the influence of abiotic factors on SOC and GHG dynamics under *Miscanthus*.

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, CH_4 and N_2O 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 the treatments were compared to assess their effects on C inputs and outputs to the soil.

Both CH_4 and N_2O emissions were below detection limits, mainly due to a lack of fertiliser additions and limited management of the agricultural site. However, 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. Results to date indicate that 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.

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 to partition belowground trace gas efflux by plant input and over time.