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Effects of Different Management Practices on the Photosynthetic Performance and Carbon Budget of a Spring Barley Crop: Scaling Fluxes from the Leaf to Ecosystem

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In Ireland agriculture is the single largest contributor to greenhouse gas emissions, comprising $\sim$28% of the total national emissions. In order to reduce these, various mitigation strategies are being investigated in cropland ecosystems, including the use of reduced-tillage and associated management modifications. In this work an assessment is being made of the impact of conventional (CT) and reduced-tillage (RT), as well as residue incorporation (RI), natural regeneration (NR) and cover cropping (CC) on the carbon budget of an arable ecosystem with barley as the main crop.

Measurements of Net Ecosystem CO_2 Exchange (NEE) using eddy covariance (EC) techniques shows that NEE of a spring barley crop under reduced tillage with residue incorporation and mustard as a fallow season cover crop represents a stronger carbon sink (RT+RI+CC $\sim$3.44 t C ha^{-1}) when compared to conventional tillage management with residue incorporation (CT+RI $\sim$1.85 t C ha^{-1}). In addition, the photosynthetic performance of both the barley and mustard plants has been assessed at the leaf level in order to characterize gross primary productivity (GPP). After the first spring-growing season, statistical analyses showed that there were no significant differences in leaf-level photosynthesis between the CT and RT treatments nor between CC, RI and NR treatments. Also leaf respiration did not differ significantly between treatments.

The leaf level data suggest that the different management practices have no significant impact on the carbon exchange of the plants in the short term. However the EC data suggest that cover cropping may increase the carbon sink strength of these arable ecosystems. We will continue to collect EC, leaf level photosynthesis, meteorological and biomass data to assess the longer-term impacts of the different management systems. In addition, the one possible model, PIXGRO, will be used to scale the carbon budgets for these cropland ecosystems from leaf level to the ecosystem scale. We expect that multiannual measurements will clarify both the trends shown during the first growing season and the accuracy of modeled carbon budgets.

Keywords: Net ecosystem C exchange, arable ecosystem C budget, ecosystem C modelling, reduced-tillage, gross primary productivity.