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Cover crops do not increase C sequestration in production crops: evidence from 12 years of continuous measurements

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The numerous reports on carbon (C) loss from cropland soils have recently raised awareness on the climate change mitigation potential of these ecosystems, and on the necessity to improve C sequestration in these soils. Among the multiple solutions that are proposed, several field measurement and modelling studies reported that growing cover crops over fall and winter time could appear as an efficient solution. However, while the large majority of these studies are based on SOC stock inventories and very few information exists from the CO₂ flux dynamics perspective. In the present work, we use the results from long-term (12 years) eddy-covariance measurements performed at the Loncée Terrestrial Observatory (LTO, candidate ICOS site, Belgium) and focus on six intercrop periods managed with (3) and without (3) cover crops after winter wheat main crops, in order to compare their response to environmental factors and to investigate the impact of cover crops on Net Ecosystem Exchange (NEE). Our results showed that cumulated NEE was not significantly affected by the presence of cover crops. Indeed, while larger CO₂ assimilation occurred during cover crop growth, this carbon gain was later lost by larger respiration rates due to larger crop residue amounts brought to the soil. As modelled by a Q10-like relationship, significantly larger R10 values were indeed observed during the three intercrop periods cultivated with cover crops.

These CO₂ flux-based results therefore tend to moderate the generally acknowledged positive impact of cover crops on net C sequestration by croplands. Our results indicate that the effect of growing cover crops on C sequestration could be less important than announced, at least at certain sites.