

Evidence for soil carbon enhancement through deeper ploughing at pasture renovation on a Pallic soil

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Permanent pastures require periodic renewal (cultivation and re-sowing) to maintain their productive potential, which involves a short-term carbon (C) loss. Normal cultivation (ploughing or discing) often involves only the top 10–15cm, or less, of pasture soils. In lysimeter experiments, the inversion of a Pallic topsoil rich in particulate C accelerated C loss in the inverted layer unless pastures with deep-rooting plants were included. Contrasting results were found in a re-grassing field trial established in 2011 to assess the effect of deeper ploughing (25 cm) in the same imperfectly drained Pallic soil (Tokomaru silt loam). The site was core sampled (0–30 cm) two (2013) and four (2015) years after cultivation and re-grassing with ryegrass + white clover swards (Till treatment) to assess changes in soil C content at different depths. At both dates, an adjacent uncultivated ryegrass paddock (representing the original uncultivated pasture – Pasture treatment) under similar grazing intensity was also sampled and C stocks compared. Profiles of cultivated soils (Till, pooled data for 2013 and 2015) showed higher ($P < 0.01$) C stocks than the adjacent permanent pasture at the nominal 15–25 and 25–30 cm depths and significantly lower ($P < 0.01$) C stocks at the topsoil (nominal 0–5 cm depth). These findings imply that the differences Till – Pasture are consistent after four years of cultivation and deep ploughing at pasture renewal had resulted in an overall increase in soil C mass to 30 cm ($\approx 18\%$; 11 Mg C/ha) compared to not undertaking the re-grassing. This gain in soil C may be temporary but in a period of 4 years it has significantly increased the net residence time of C in soil related to the soil inversion.