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Carbon sequestration in maize and grass dominant cropping systems in Flanders

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Sources of soil organic matter (SOM) input to the soil in agro-ecosystems are typically crop residues. The question arises how removing crop residues from a field influences soil carbon sequestration. We investigated four long-term maize and grass dominant cropping systems each with a different residue management. Under silage maize (SM) all stover is removed from the field and only a stubble remains, whereas under grain maize (GM) only the grains are harvested and all stover is returned to the soil. Fields with a history of at least 15 consecutive years of either SM (with or without a second annual crop of Italian ryegrass) or GM, and fields under permanent grass were selected from a geodatabase that covers 15 years of crop rotation for all of the ca. 500,000 agricultural fields in Flanders. For each cropping system 10 fields were sampled (40 in total) following the area-frame randomized soil sampling (AFRSS) protocol (Stolbovoy et al., 2007). For 6 out of 10 fields only the topsoil was sampled (0-30 cm), whereas for the 4 other fields both topsoil and subsoil (30-60 cm and 60-90 cm) were sampled. The total soil organic carbon (SOC) and nitrogen content and the stable carbon isotope ratio ($^{13}C/^{12}C$) were determined for each soil sample. From each field 1 topsoil sample was fractionated by the Zimmermann fractionation procedure (Zimmermann et al., 2007) which distinguishes between 5 different SOC fractions (POM, DOC, silt and clay associated SOC, chemically resistant SOC, SOC associated with sand fraction). Besides analysis of the SOC and nitrogen content of each fraction, the origin of the carbon was determined through isotope-ratio mass spectrometry. Although there was no significant difference between SM and GM regarding the total SOC stock for the upper 30 cm (ca. 75 à 80 Mg C.ha^{-1}), fields under continuous GM contained in the 0-30 cm layer 60% more maize-derived C_4-SOC as compared to fields under continuous SM (ca. 14 and 9 Mg C.ha^{-1} respectively). Significant differences could also be demonstrated for the carbon fractions of soils with different cropping histories. Each fraction of a GM-topsoil contained significantly more C_4-SOC as compared to a SM-topsoil (with or without a second annual crop) with the sizes of the fractions being equal. The more labile POM- en DOC-fractions accounted for the biggest part of the maize C_4-SOC detected in the bulk sample, whereas the silt and clay associated SOC and chemically resistant SOC consisted mainly out of old grass C_3-SOC. For the deeper soil layers no significant differences could be demonstrated between GM and SM, neither for the total SOC stock nor for the C_4-SOC stock. Our results suggest that the soils with maize cropping systems in Flanders are near carbon saturation, such that crop residue management does not influence the total amount, but rather the quality of the carbon sequestered.

Stolbovoy, V., Montanarella, L., Filippi, N., Jones, A., Gallego, J., and Grassi, G. (2007). Soil sampling protocol to certify the changes of organic carbon stock in mineral soil of the European Union. Version 2. EUR 21576 EN/2. Office for Official Publications of the European Communities, Luxembourg. 56p.

Zimmermann, M., Leifeld, J., Schmidt, M.W.I., Smith, P., and Fuhrer, J. (2007). Measured soil organic matter fractions can be related to pools in the RothC model. European Journal of Soil Science, 58: 658-667.