Allocation of carbon and nitrogen in size-fractions of New Zealand pasture soils

Roberto Calvelo Pereira[1], Marta Camps Arbestain[1], Carolyn Hedley[2], Jeff Baldock[3], Stanilave Garbuz[1,4]
[1]Institute of Agriculture and Environment, Private Bag 11222, Massey University, Palmerston North 4442, New Zealand, [2]Landcare Research, Private Bag 11052, Palmerston North 4442, New Zealand, [3]CSIRO Land and Water, Glen Osmond, South Australia 5064, Australia, [4]Dokuchaev Soil Science Institute, Moscow, Russia

Soil physical fractionation according to size and/or density of soil particles can improve our understanding of the importance of interactions between organic and inorganic soil components on the turnover of soil organic carbon (SOC). Different C fractions can be isolated by physical fractionation and included in models (e.g. RothC). In the end, however, cost-effective and practical methods including mid- and near-infrared spectroscopy (MIR, NIR) are preferred to measure SOC and its composition. In this study, a combination of wet sieving, dispersion and chemical analysis (dichromate oxidation) was tested to isolate meaningful SOC fractions in a set of 10 New Zealand pasture soils (at two depths, 0–10 cm and 10–30 cm) of contrasted texture (sand to silt loam) and SOC content (6.7–95.0 g SOC/kg). The appropriate blend of chemical analyses allowed the isolation of soil carbon fractions equivalent to those identified previously: particulate, humus and resistant organic carbon fractions, POC, HOC and ROC, respectively. The content of resistant forms of SOC (e.g., pyrogenic C; alkyl C) was calculated as the sum of the non-oxidisable C (or dichromate-resistant C) obtained in the different fractions separated by wet sieving and dispersion. On the other hand, MIR spectra from the same samples were obtained and later used to predict content of total C, POC, HOC and ROC, based on MIR/partial least squares regression algorithms developed for Australian soils. Across the all the soils considered, the allocation of SOC obtained by wet sieving and chemical treatment showed a remarkable agreement with the predicted data for total C and the different pools ($R^2 \geq 0.88$; $P < 0.0001$; $n = 20$). The sensible combination of methodologies (wet chemistry, spectroscopy) may hence facilitate the measurement of fractions of SOC replacing conceptual pools in models constructed to predict SOC dynamics.