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BOOK OF ABSTRACTS

Some indicators of organic carbon status in Norwegian agricultural soils

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Diverse pedoclimatic zones lead to large variations in soil organic carbon (SOC). Key questions involve how much carbon the soil contains, what is its potential for more storage and whether levels are sufficient to maintain soil structure stability (SSS). We evaluate current SOC levels using ratios of clay/silt fractions to SOC, to identify potential SOC storage areas and to gauge likely SSS status.

SOC retention is affected by clay and silt, which protect it from microbial activity. Hassink (1997) used the ratio of clay plus silt <20 µm (fines20) to SOC to indicate this relationship, whilst Dexter et al. (2008) used the ratio of clay to SOC. Jensen et al. (2019) found critical ratios for SSS to be ~10 for clay/SOC and ~20 for fines20/SOC, above which SSS is impaired and below which SOC is less likely to be retained. These ratios appear valid under Norwegian conditions, where greatest declines in SOC have been found in soils with high initial SOC levels and lowest declines in clay soils (Riley & Bakkegard 2008).

After 28 years of a cropping system trial in eastern Norway (Riley et al. 2022), equilibrium between SOC gains and losses was at a fines20/SOC ratio of ~18, whilst in the same trial SSS declined sharply in an arable cropping system with a clay/SOC ratio >10, compared to systems with ratios of 6-8. In western Norway, on grassland soils with generally low fines20/SOC ratios, SOC appears to be declining despite manure inputs, especially in cases with high initial SOC levels (Rittl et al. 2023). To obtain insight into the potential for SOC across Norway, data was used from a study in which SOC and soil texture was analysed on 600 fields in agricultural districts throughout the country. Results are grouped into 13 regions with relatively uniform climate and cropping within each.

Greatest proportions of fields with high ratio levels were found in regions around Oslo and east of Oslofjord, with predominantly clay and silty clay loams, where 65% of fields had clay/SOC >10 and 80% had fines20/SOC >20. Proportions of fields with fines20/SOC >20 were somewhat lower west of Oslofjord (65%) and in central Norway (44%), where many soil textures are found, and in an inland region with predominantly silty soils (55%). Proportions of fields with high ratio levels were low in inland regions with loam soil, where 15-20% had clay/SOC >10 and 24% had fines20/SOC >20. All these regions are mainly arable, with some livestock, and mean SOC levels are <3,0%.

In the predominantly grassland/livestock regions of southern, western and northern Norway, and in upland areas, the soils are mostly sandy and silty loams, and mean SOC levels are mostly >3,5%. In these regions, the proportion of fields with clay/SOC >10 was below 5% whilst that of fines20/SOC >20 was below 10%. Mean clay/SOC ratios were 1-3 and mean fines20/SOC ratios were 4-10. Arable land has thus greater potential for carbon storage than grassland, whilst at the same time increasing SSS and reducing erosion risk.

Keywords: texture; arable; grassland; storage; stability

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