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Effects of foundry sand addition on yield, penetration resistance and CO_2 emission from an agricultural peat soil

Örjan Berglund, Sabine Jordan, Kathrin Hesse, and Kerstin Berglund
Swedish University of Agricultural Sciences, Soil and Environment, Uppsala, Sweden (orjan.berglund@slu.se)

Peatlands store a large share of the world's soil organic carbon and are widespread in Northern and Central European countries. Drainage is a precondition for traditional agricultural production on organic soils. Drainage increases peat mineralization and changes the physical and chemical soil parameters. Only a few decades after initial drainage, agricultural systems on drained organic soils start experiencing a high risk of crop failure. Decreased hydraulic conductivities lead to decreased infiltration, ponding, and finally to abandonment as drainage will not be effective anymore. Another problem is the low trafficability.

The aim of this experiment is to investigate if the addition of foundry sand to the top soil will improve the trafficability and how it will affect the yield and CO_2 emission. In the Swedish part of the EU-funded PEATWISE project, a field experiment (randomized block design, 3x3) was set up at a former cultivated, but now abandoned, fen peat located at Bälinge Mossar (60.03N, 17.43E). We compare trafficability (as penetration resistance), yield and CO_2 emission from plots sown with Timothy (*Phleum pratense*) treated with 0 cm (control), 2.5 cm or 5 cm foundry sand. The sand was applied in autumn 2015 and mixed in the top 10 cm of the soil. CO_2 emissions were measured with automatic chambers taking 12 measurements per day in frames where vegetation was removed.

The penetration resistance was slightly higher for the plots with sand addition 2016 and 2018. The yield 2017 was highest from the plots with 5 cm sand (11.6 t d.m. / ha), lowest from plots with 2.5 cm sand (8.8 t d.m. / ha) and the control yielded 10.3 t d.m. / ha. In 2018 the yield was highest from the control (13.8 t d.m. / ha), lowest from plots with 2.5 cm sand (12.6 t d.m. / ha) and 12.7 t d.m. / ha from plots with 5 cm sand.

The CO_2 emission during autumn 2015 (15/9-1/11) was highest from the plots without sand addition (3.4 μmol $m^{-2}s^{-1}$) and lowest from the plots where 5 cm sand was added (1.4 μmol $m^{-2}s^{-1}$). The emission from plots with the 2.5 cm treatment was 1.8 μmol $m^{-2}s^{-1}$. During 2016 (4/5 – 27/9), the emissions were lowest from the plots treated with 5 cm foundry sand (4.26 μmol $m^{-2}s^{-1}$), and highest from the plots with 2.5 cm sand (6.10 μmol $m^{-2}s^{-1}$). The untreated plot had an average CO_2 emission of 5.09 μmol $m^{-2}s^{-1}$. The 5 cm plots had lowest emission 2017, emitting an average of 4.53 μmol CO_2 $m^{-2}s^{-1}$ whereas the 2.5 cm treatment emitted 4.87 μmol CO_2 $m^{-2}s^{-1}$and the 0 cm treatment 5.92 μmol CO_2 $m^{-2}s^{-1}$. The same pattern was observed also 2018 (11/4 – 28/10) where the 5 cm plots emitted least, on average 6.82 μmol $m^{-2}s^{-1}$ and the control had the highest emission, 7.15 μmol $m^{-2}s^{-1}$. As a measure for CO_2 emission reduction and a better trafficability we recommend the addition of foundry sand on agricultural peat soils.