CO2 EMISSIONS FROM CULTIVATED PEAT SOIL WITH SAND ADDITION A CAOS PROJECT

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SUMMARY

Peatlands store a major 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 fosters peat mineralization and changes the physical and chemical soil quality. Only 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 in this experiment is to investigate if the addition of foundry sand to the top soil will improve the trafficability without increasing the CO2 emission. In the Swedish part of the EU-funded CAOS project, a field experiment (randomized block design, 3x3) was set up at a former cultivated, but now abandoned, fen peat located at Bälinge Mossar (60.02821N, 17.43008E). We will compare trafficability, yield and CO2 emission from plots sown with Phleum pretense and treated with 0 cm, 2.5 cm or 5 cm foundry sand. The sand was applied in the autumn of 2015 and mixed in the top 10 cm of the soil. Penetration resistance, yield and CO2 emissions will be compared during three years. The first preliminary results (15/9-1/11) show that the CO2 emissions are 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 the 2.5 cm treatment was 1.8 µmol m^{-2} s^{-1}.

Yield and trafficability have not been measured yet, but initial emission results are promising with no increase of CO2 emissions with sand application.

KEYWORDS
Peat, CO2, sand, CAOS

INTRODUCTION

Peatlands store a major share of the world's soil organic carbon and are widespread in Northern and Central European countries (Görres et al. 2014). Drainage is a precondition for traditional agricultural production on organic soils (Berglund 1996). Drainage fosters peat mineralization and changes the physical and chemical soil quality and it can affect the CO2 emission (Berglund et al. 2011). Only 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 connected to the high water table level (Myllys 1999).

In this article we describe a field trial where we added foundry sand to a cultivated peat soil to investigate how it effect the bearing capacity, trafficability and CO2 emission.

METHODS

In the Swedish part of the EU-funded CAOS project, a field experiment (randomized block design, 3x3) was set up at a former cultivated, but now abandoned, fen peat located at Bälinge Mossar (60.02821N, 17.43008E). The plots was sown with Phelum pretense and treated with 0 cm, 2.5 cm or 5 cm foundry sand (Figure 1). The sand was applied in the autumn of 2015 and mixed into the top 10 cm of the soil.

Figure 1. Foundry sand spread on Broddbo field trial.

Penetration resistance was measured 10 times per plot down to a depth of 50 cm with a penetrometer from Eijkelkamp. CO2 emission from the soil was measured every second hour with automatic chambers from ADC Bioscientific (Herts, England) using the dark chamber method (Martikainen et al. 1995).Yield and trafficability have not been measured yet.

RESULTS

The summer of 2015 was very wet (Figure 2) and it was not until September that the groundwater level was low enough for traffic and we could spread the foundry sand.

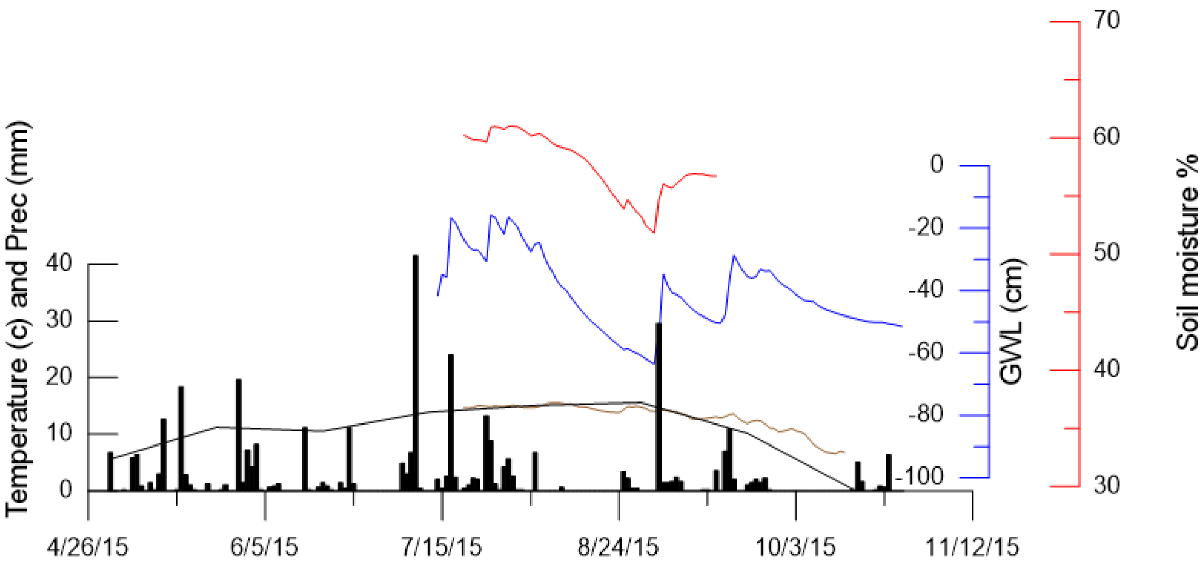

Figure 2. Precipitation, Air (black line) and Soil Temperature (brown line), Groundwater level (blue line) and soil moisture (red line) 2015 at Broddbo Field Site.

Penetration resistance was measured after the sand was mixed into the top 10 cm. Since the soil was not re-packed, it was very loose and the penetration resistance very low and no significant differences were found (Figure 3).

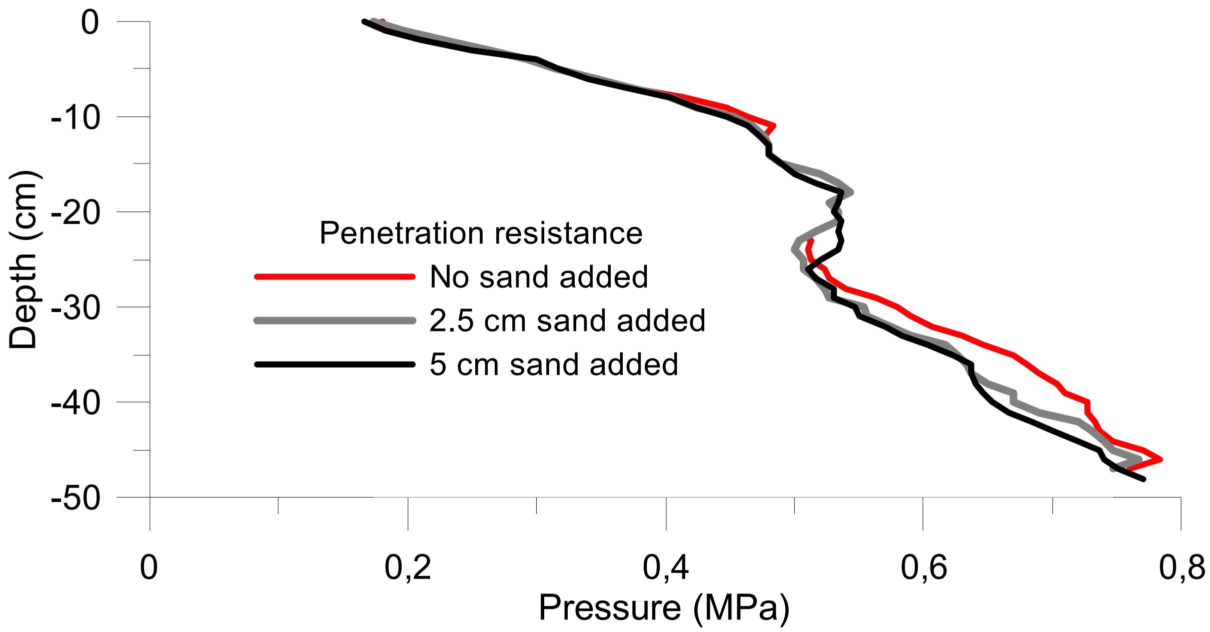

Figure 3. Penetration resistance. Average of 10 measurements per plots and 3 plots per treatment.

Since the foundry sand was added so late in the season, also the CO2 measurements started quite late and stopped in the beginning of November. There was a consistent trend that CO2 emission was largest from the plots were no sand was added, and lowest from the plots where we added most sand (Figure 4). The CO2 emissions are 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 the 2.5 cm treatment was 1.8 µmol m^{-2} s^{-1}.

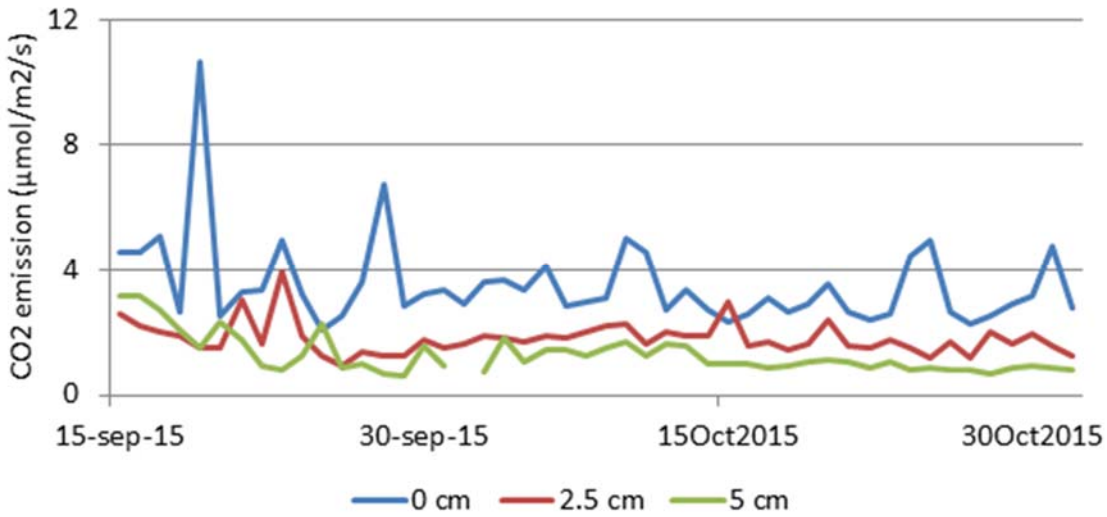

Figure 4. CO2 emission from plots with 0, 2.5 and 5 cm of foundry sand added.

DISCUSSION

This is the first season of measurements with-in this project and a very short period with CO2 measurements. Still it is interesting that it seems that the addition of foundry sand might have lowered the CO2 emission rate. How and if it affects the penetration resistance and trafficability will be interesting to investigate after the winter when the soil will have consolidated. Sand has been used to improve soils in general (Lindsay et al. 2005) and in peat soils in particular (Osvald 1937) where the yield and trafficability was improved by adding sand or clay to peat soils.

CONCLUSION

During the autumn CO2 emission rates were lowest from the treatment where 5 cm of foundry sand was added and highest from the reference-plots. No difference in penetration resistance could be shown directly after mixing in the sand into the soil.

ACKNOWLEDGMENTS

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 618105.

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