Growing hemp in Scotland: Impact on soil health and Crop Yield

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Introduction

Scotland's ambitious target of net-zero GHG emissions by 2045 calls for a holistic approach across industry, research, education and government, as well as changing individuals' behaviour. Increasing agricultural diversity by inclusion of crops such as hemp could be a key component in the sectors response towards the mitigation of GHG emissions. As well as the nutritional and fibre benefits of hemp, it brings environmental advantages due to its capacity for carbon sequestration, contribution to greater biodiversity, land recovery and remediation. Agricultural hemp could become a new 'cash-crop' for Scottish agriculture and play a role in the development and expansion of a low carbon environmentally responsible industry, bringing and creating new opportunities across the supply chain.

Aim

This pilot study started in 2023 and is collecting data on soil health and crop yield and nutritional quality at three Scottish Farms to explore the possibility of introduction of hemp as a rotational (break crop) crop in Scotland.

Methods

From 2021, eleven different farms were growing agricultural hemp for seed in Northeast Scotland (Figure 1) for the very first time and in 2022 the first Scottish commercial hemp oil was produced. Three of these farms provided samples for this pilot study (Figure 1).

The first set of soil samples were collected in Spring and Autumn of 2023 after one season of growing hemp and the second set collected in Spring 2024 after one season of growing hemp (Hemp Fields; Figure 1). The Spring 2024 soil samples were compared with soil after growing a cereal crop in the same year at the same farms (Control Fields; Figure 1). Farm 1 and 3 had variety Finola and Farm2 Estica (Field 1) and Finola (Field 2).

The soil samples were measured for their carbon content (C%), nitrogen content (N%), percent moisture loss, loss on ignition (LOI) at 450 ºC and 900 ºC, mineral content, pH, and content of plant growth hormones using established methods (1, 2).

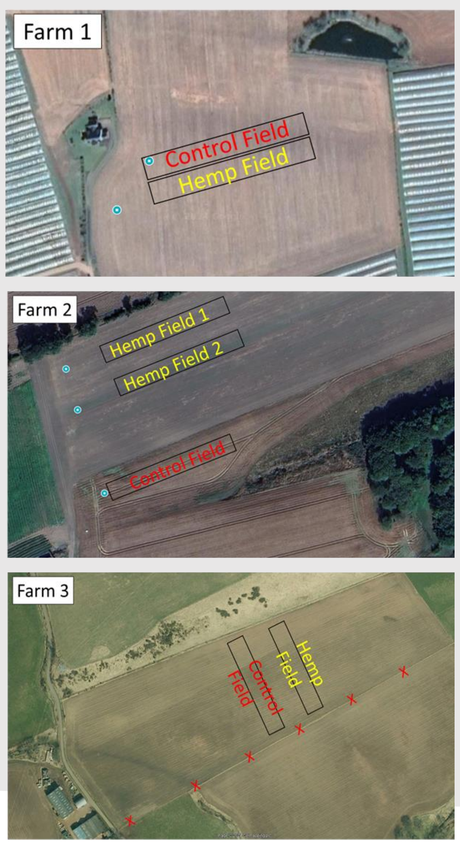

Figure 1 – Location of the farms growing hemp in the Northeast of Scotland, including the position of the fields used in the pilot study for soil sampling from Farms 1, 2 and 3.

Results

Following hemp production at all farms, there was an increase in soil pH levels from spring to autumn 2023. For two farms the increase was significant (Figure 2 A). The LOI at 450 ºC and 900 ºC also showed significant increases from spring to autumn 2023 on all farms (Figure 2 B).

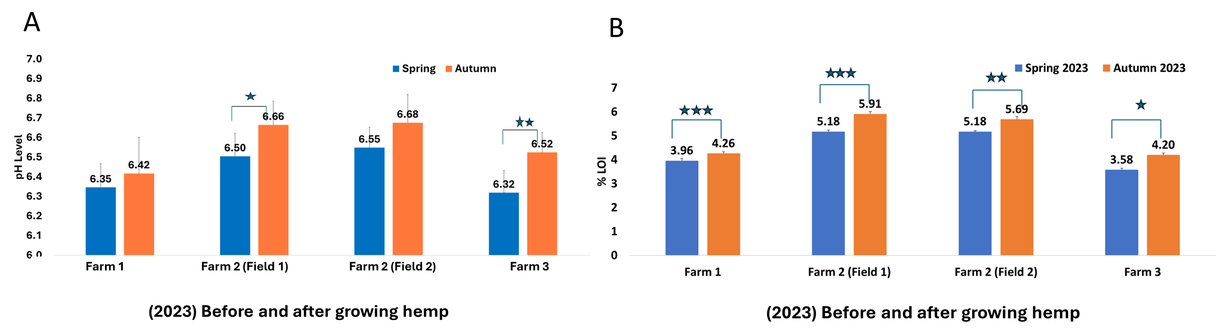

Figure 2 – Average pH values (n=7; mean ± stdv) of soil samples measured in spring 2023 (before hemp sowing) and autumn 2023 (after hemp harvest) (A); Average Loss on Ignition at 450 °C of soil samples measured in spring 2023 (n=3; mean ± stdv) (before hemp sowing) and autumn 2023 (n=4; mean ± stdv) (after hemp harvest) (B). Where, (*- p<0.05; **- p<0.01 and ***- p<0.001).

Comparing the soil samples collected after growing hemp and a cereal crop on the same farm in the same year, it was show that the percentage of Soil Nitrogen (%N) and the percentage of Soil Organic Matter (%SOM) was significantly increased following hemp production in two out of the three farms, (Figure 3 A, B); and the Carbon to Nitrogen ratio was significantly reduced and the LOI at 450 ºC and 900 ºC was significantly higher in two out of three farms, following hemp production (Figure 3 C).

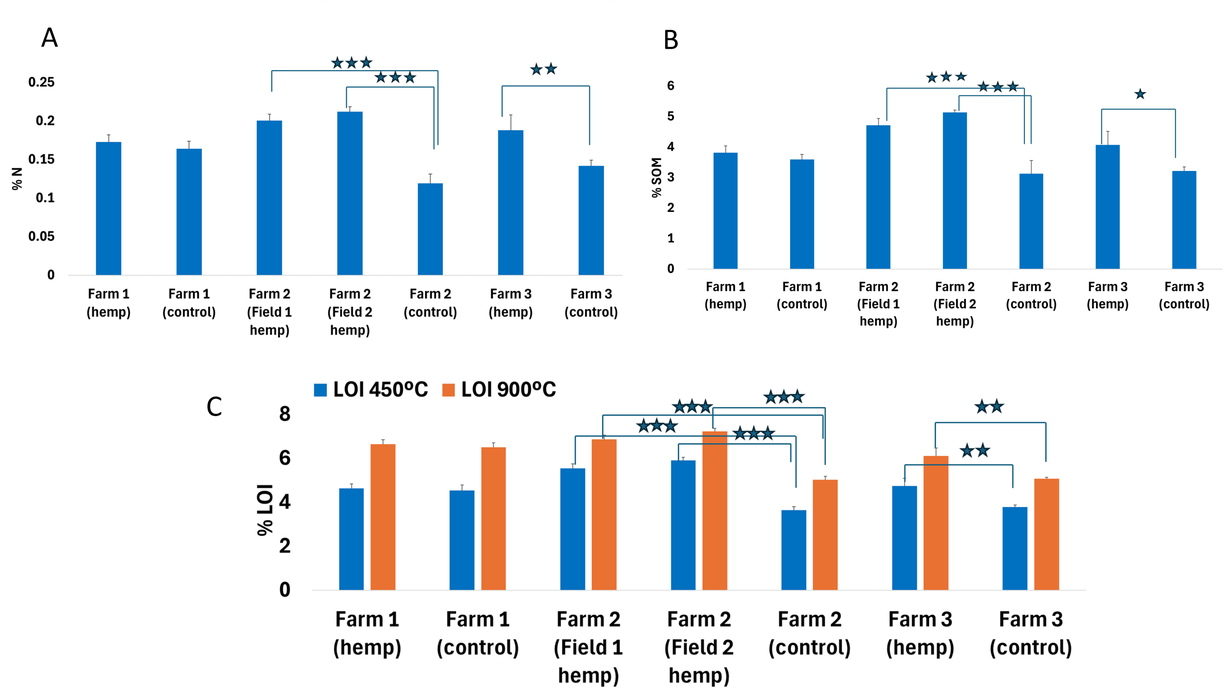

Figure 3 – Percentage of Soil Nitrogen (%N) (A), Soil Organic Matter (%SOM) (B) and Loss on Ignition (LOI) at 450 ºC and 900 ºC (C) (n=4; mean ± stdv) of samples collected from fields following hemp and respectively a cereal crop production. Where, (*- p<0.05; **- p<0.01 and ***- p<0.001).

Preliminary conclusions and planned future work

- These preliminary findings suggest that hemp could potentially enhance soil health and support its inclusion as a rotational crop, sustaining the implementation of a larger scale agricultural trial including the soil physical and biological characteristics.
- Further assessments of the impact of hemp on the yield and nutritional value of a subsequent cereal crop, and the impact on the soil characteristics will also be assessed as part of this study.

Acknowledgement

This work was funded by the Scottish Government's Rural and Environment Science and Analytical Services (RESAS) Strategic Research Programme 2022–2027 (project RI-B1-1). Special thanks to the farmers who took part in this study and supplied the soil samples and to the Analytical Department from The Rowett Institute and the James Hutton Institute for their help with samples analysis.

References

(1) Eley, Y.; White, J.; Dawson, L.A.; Hren, M.; Pedentchouk, N. (2018) Variation in hydrogen isotope composition among salt marsh plant organic compounds highlights biochemical mechanisms controlling biosynthetic fractionation., Journal of Geophysical Research – Biogeosciences, 123, 2645-2660.

(2) https://www.sfu.ca/geog/soils/lab_documents/Estimation_Of_Organic_Matter_By_LOI.pdf