Background

The Arctic is warming at twice the global average, offering better agricultural conditions in South Greenland. However, knowledge of the physical properties of the Greenlandic agricultural soils is scarce, presenting a critical knowledge gap for agricultural production in the region. The soils have been characterized as coarse-grained, little developed, and highly organic, indicating a poor water-holding capacity, soil aeration, and soil water repellency (SWR). Large quantities of very fine-grained glacial deposits, i.e., glacial rock flour (GRF), are present in the South Greenlandic landscape. Due to their high content of clay- and silt-sized minerals, these deposits could serve as a soil amendment to reduce the SWR and improve the physical properties of the Greenlandic soils by boosting their structural development.

Aim

- Describe and evaluate a wide range of physical properties of Greenlandic agricultural soils
- Locate and describe the resources of GRF in South Greenland and test their capability to serve as a soil amendment.

Materials and Methods

More than 500 natural soils were sampled in 100 cm³ soil cores from 24 fields. Analyses included soil composition, particle density, soil-gas diffusivity, air permeability, wet- and dry-region soil water retention, saturated hydraulic conductivity, mechanical properties, and SWR.

A total of 16 high-quality terrestrial GRF deposits were located and analyzed for, e.g., mineralogy, elemental composition, texture, OC, specific surface area, pH, nutrients, and CEC.

Two randomized field experiments were established to evaluate the effect of GRF (0 – 500 t ha⁻¹) on physical soil properties and plant yield.

Results

Natural soils

- Coarse texture, high OM
- Extremely hydrophobic
- Poor soil structure
- Poor water retention
- Poor soil aeration
- Poor mechanical strength
- Very low pH

GRF amended soils

- Reduced hydrophobicity
- Improved soil structure
- Improved water retention
- Improved yield
- Improved nutrient uptake

Conclusions

Natural soils:
- The Greenlandic agricultural soils can provide the basic physical functioning for agriculture.
- However, the physical functioning of the soils is contingent on a high content of organic matter.
- Thus, soil functioning may deteriorate severely if the organic matter is depleted.
- The extreme degree of soil water repellency should be considered carefully in present and future irrigation management.

GRF as a soil amendment:
- High-quality GRF is readily available for farmers.
- Early results from two field experiments showed promising results for SWR but ambiguous results for crop yield.

Future Research

- Integrated physical analyses from pedon to landscape
- Investigations into the organo-mineral complexation of GRF
- It is needed to evaluate the long-term effects of GRF application before commercial use

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Publications


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