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Rejuvenation of nutrient poor soils with glacial rock flour

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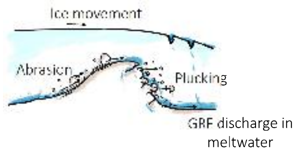
Introduction:

The areas with highest agricultural productivity in the World are found along the margins of the ice cap during the last glaciation (see map to the right). Receding glaciers deposited glacial till and rock flour on these soils making them juvenile compared to soils in the tropics. Many tropical soils have lost their fertility through long term weathering and leaching.

This work proposes introduction of Greenlandic rock flour (GRF) to nutrient poor soils for enhanced fertility. GRF is an immense unutilized resource, the annual deposition in rivers, fjords and lakes has been estimated around 1 billion tons. Due to high-energy abrasion during glacial movement, the produced GRF is has much finer particle size than mechanical crushed rock powders.

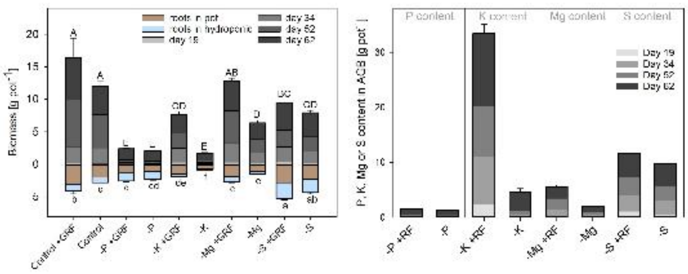


Hypotheses:

- GRF can rejuvenate weathered soils and enhance their fertility
- GRF can supply macro-nutrients to plants (Experiment I)
- Si supplied from GRF can enhance plant P nutrition (Experiment II)

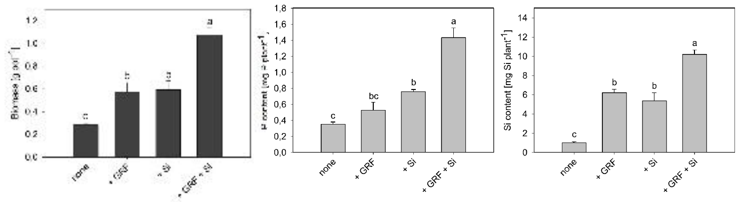
Experiment I: Macro-nutrient supply by GRF:

In double-pot systems ryegrass was grown with unlimited access to nutrients from hydroponics. By omission og single nutrients in hydroponics, plants relied on above compartment which was filled with sand +/- GRF.



Experiment II: Si effects on plant growth under P limitation:

Wheat grown for 42 days in a Brazilian oxisol. Plants grew in growth chamber with all nutrients added in sufficient amounts except P which was only added at a low dose (10 mgP kg^{-1} soil). Liquid Si was added every 3 days as $Na_2O_3Si \cdot 5H_2O$.



Conclusions

- GRF has potential to enhance fertility and productivity of nutrient poor soils
- GRF supplied K and Mg but not P or S to plants (Exp. I)
- Plants took up 4.4% of total K applied with GRF in 62 days, indicating GRF's potential as a slow release K fertilizer (Exp. I)
- GRF was not able to supply P directly, however Si released from GRF or added liquid Si could enhance the availability of soil P or enhance the plants ability to take up P from the soil (Exp. II).
- GRF does not have a liming effect (Exp. II data not shown)

GRF properties:

Origin	Total P [%]	Total K [%]	Total Mg [%]	Total Ca [%]	Total S [%]	SiO_2 [%]	Al_2O_3 [%]	Particle size range [µm]	50 % of particles [µm]	Surface area [m^{2}g^{-1}]
Maalutu, raised seabed	0.05	2.38	1.59	2.65	0.02	62.8	15.7	0.3-100	< 9.8	0.52
Mineralogy:	quartz: 22%, plagioclase: 40 %, K-feldspar: 13%, mica (mainly biotite): 11%, amphibolite: 11 %, clinopyroxene: 3 %