

# **Plant growth as an indicator of silicate mineral weathering: a carefully controlled laboratory study**

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CO<sub>2</sub> removal depends on evidence of rock weathering in soils. To demonstrate weathering, we have carried out controlled experiments to investigate delivery of K for plant growth, motivated by the current high price of K (World Bank Blogs [1]) and long history of study which dates back to Goldschmidt 1922. Bakken et al [2] reported that K from nepheline and biotite can be taken up by grass, and these minerals supplied K similar to KCl fertiliser (Bakken et al [3]), providing evidence of silicate rock weathering in soils.

Experimental design was carefully implemented following the study of Manning et al [4]. The 8 week-experiment was an undrained system, to avoid loss of the nutrients. To ensure that the treatment was the only source of K, high purity quartz sand (SSO) and the rock dust of interest were tested by measuring the diameter of leek plants. The source of K was from refined nepheline syenite (NSO), nepheline syenite tailings (NST), dolerite (BML), alkaline basalt (BDC) and granite (GNO). NSO dominantly contains K-feldspar and nepheline as sources of K, while NST mainly is composed of biotite and some K-feldspar and nepheline. BML and BDC are both composed of K-feldspar, but a different amount. GNO contains K-feldspar and biotite, but no nepheline. All rock dusts were amended separately with 5 replicates to provide 22 mg K/pot. NST supported the highest observed increase, (~1 mm). NSO was the second most effective with a diameter increase of 0.8 mm, followed by BML (0.65 mm increase), BDC (0.5 mm increase). The GNO showed the similar growth pattern to the negative control (SSO) with approximately 0.4 mm increase. As the growth rate was twice as much as other treatments, nepheline-bearing rocks are more of interest as sources of K. The results are in accordance with log K dissolution rate constants suggested by Palandri and Kharaka [5]. Nepheline (-2.73) will be completely dissolved quicker than K-feldspar by nearly four orders of magnitude (Hangx and Spiers [6]) from an initial grain size of 10 mm, at pH 5.5 and 25 °C.

[1]<https://blogs.worldbank.org/opendata/fertilizer-prices-expected-remain-higher-longer>

[2]<https://doi.org/10.1007/BF01985717>

[3]<https://doi.org/10.1023/A:1009709914578>

[4]<https://doi.org/10.1016/j.scitotenv.2016.09.086>

[5]<https://pubs.usgs.gov/of/2004/1068/>

[6]<https://doi.org/10.1016/j.ijggc.2009.07.001>