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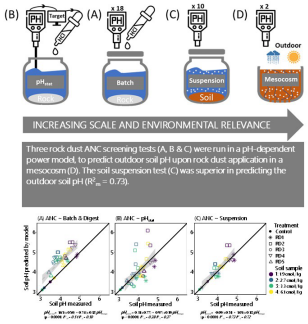

A comparison of silicate rock dusts and accelerated weathering tests to assess the slow-release liming effects in acid soils.

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Silicate rock dusts (RD) are promoted as soil amendments to restore acid soils but the quality of these products is variable and lacks proper assessment protocols. To address this, three accelerated RD weathering tests were conducted on five commercial RD's and compared with a fourth mesocosm experiment assessing their gradual liming effects in acid soils.

First, RD dissolution was measured during one year at various starting pH (3.5-5.5) and constant temperatures (20-65°C) using manual titration in batch renewal systems. These illustrated that the acid neutralizing capacity (ANC) of RDs shows a fast fraction (half-life <1 day) followed by a slower fraction.

Second, pH_{stat} tests with an automatic titrator performed between pH 3.5 and 4.5 revealed the surface normalised dissolution rates that decreased by a factor 10-100 per unit pH increase, depending on the RD. The ranking of RD weathering rates by mineralogy-derived rates coincided to measured weathering rates confirming the large importance of mineral composition.

Third, lime-calibrated agitated soil-RD suspension tests were conducted during two months. These yielded ANC's that were factor 2-7 times larger than in the batch tests because of larger pH and cation concentration buffering in soil suspension than in aqueous solution while yielding smaller variability between RD ANC than ANC measured by pH_{stat} titrations.

Finally, an outdoor soil mesocosm monitored soil pH during 1.2 years on four different acid soils to find the most suitable accelerated weathering test to predict in situ pH. Mesocosm pH corresponded best (R^2_m = 0.73) with predictions made using a power model calibrated to the soil suspension ANC data and to the pH and temperature dependent surface normalised dissolution rates from the pH_{stat} tests (graphical abstract, third panel). The model predicts that half-lives of slow ANC-fractions at a dose of 12 Mg/ha in soils increase with increasing start pH from 0.5-4 days at pH 3.5 up to 250 days-100 years at pH 5.5, the range depending on the pH buffer power of the soil, RD mineralogy and specific surface area.

In conclusion, to assess the long-term weathering of RDs as soil amendments a novel lime-calibrated soil suspension test is recommended.