Acidulated pegmatitic mica: A promising new multi-nutrient mineral fertilizer

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Abstract

Scrap grade pegmatitic phlogopite mica contains 5–7% K (~8% K_2O), 10–14% Mg (~23% MgO), 1–2% Ca (~2.9% CaO), 0.03% Mn and 109 ppm Zn. On acidulation upto 65% of K and Mg and 15–100% Mn and Zn were recovered. Less than 13% of Ca was recovered in solution. Water soluble and Nh_4OAc extractable K and Mg of acidulated mica of pegmatitic origin increased a 10^2 to 10^3 times compared to untreated mica. Acidulated mica remained non-hygroscopic even when mixed with acids at a 2:1 mica to acid ratio. X-ray diffraction analyses demonstrated that interlayer cations were easily leached from the mica structure leaving behind a kaolinitic residue, compared to the more stable tetrasilicate feldspars.

The most significant achievement through these experiments was the yield increase obtained in the greenhouse experiment with rice by using the lowest application rate (200 kg ha^{-1}) so far reported for mica, – an exponential decrease from tonnes/ha previously reported. Acidulated phlogopite mica chips (200 kg ha^{-1}– 4 kg K, 8 kg Mg, trace elements Mn, Zn etc.) gave a yield increase of over 41% compared to a control with recommended muriate of potash and dolomite (17 kg K, 6 kg Mg). The response to acidulated feldspar (500 kg ha^{-1}– 1.5 kg K) and an acidulated feldspar-dolomite combined fertilizer (250 kg ha^{-1}– 0.6 kg K and 6 kg Mg) was not significant.

The response to mica clearly shows a multinutrient deficiency in highly weathered tropical soils. The relatively high solubility of the acidulated mica, its range of nutrient element supply, its nonhygroscopic nature and its extremely simple manufacturing process makes mica, a cheap but effective fertilizer for the tropical regions where these nutrients are deficient, especially in highly metamorphosed crystalline terrains.