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Agronomic Test to Determine the Efficiency of Hydrothermally Treated Alkaline Igneous Rocks and Their Potassium Fertilizing Capacity

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Abstract : Potassium (K) is an essential macronutrient for plant growth, helping to regulate several physiological and metabolic processes. Evaporite-related potash salts, mainly sylvite minerals (K chloride or KCl), are the principal source of K for the fertilizer industry. However, due to the high potash-supply risk associated with its considerable price fluctuations and uneven geographic distribution for most agriculture-based developing countries, the development of alternative sources of fertilizer K is imperative to maintain adequate crop yield, reduce yield gaps, and food security. Alkaline Igneous rocks containing significant K-rich silicate minerals such as K feldspar are increasingly seen as the best alternative available. However, these rocks may require to be hydrothermally treatment to enhance the release of potassium. In this study, we evaluate the fertilizing capacity of raw and hydrothermally treated K-bearing silicate rocks from different areas in Morocco. The effectiveness of rock powders was tested in a greenhouse experiment using ryegrass (Lolium multiflorum) by comparing them to a control (no K added) and to a conventional fertilizer (muriate of potash: MOP or KCl). The trial was conducted in a randomized complete block design with three replications, and plants were grown on K-depleted soils for three growing cycles. To achieve our objective, in addition to the analysis of the muriate response curve and the different biomasses, we also examined three necessary coefficients, namely: the K uptake, then apparent K recovery (AKR), and the relative K efficiency (RKE). The results showed that based on the optimum economic rate of MOP (230 kg.K.ha^{-1}) and the optimum yield (44 000 kg.K.ha^{-1}), the efficiency of K silicate rocks was as high as that of MOP. Although the plants took up only half of the K supplied by the powdered rock, the hydrothermal material was found to be satisfactory, with a biomass value reaching the optimum economic limit until the second crop cycle. In comparison, the AKR of the MOP (98.6%) and its RKE in the 1st cycle were higher than our materials: 39% and 38%, respectively. Therefore, the raw and hydrothermal materials mixture could be an appropriate solution for long-term agronomic use based on the obtained results.

Keywords : K-uptake, AKR, RKE, K-bearing silicate rock, MOP
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