Application of Andesite Rock as a Clean Source of Fertilizer for Eucalyptus Crop: Evidence of Sustainability

Adilson Celimar Dalmora; Claudete Gindri Ramos; Marcos Leandro Silva Oliveira; Luis Felipe Silva Oliveira; Ivo André Homrich Schneider; Rubens Muller Kautzmann

Abstract

Global demineralization of agricultural soils due to unsustainable use of highly soluble fertilizers and intensive exploitation is an issue of increasing concern. Methods of remineralization include the application of volcanic rock by-product, such as vesicular andesite on mineral-deficient fields. The present work analyzed the petrography, mineralogy, and chemistry of volcanic rock by-product (vesicular andesite rock), as well as on-field experiment with eucalyptus. The petrographic description was performed on a polished thin section by optical microscopy. The mineralogical phases were identified with X-ray diffraction. The by-product chemical composition was determined by X-ray fluorescence and inductively coupled plasma mass spectrometry for potentially toxic elements. Additional chemical compositions were analyzed using a scanning electron microscope equipped with a dispersive X-ray detector. A nine-month field experiment was carried out to evaluate the agronomic performance of *Eucalyptus saligna* Smith cultivated in an Ultisol. Four different doses (treatment T1 = control, treatment T2 = nitrogen, phosphorous, and potassium fertilizer 100 %, treatment T3 = by-product 100 %, and treatment T4 = by-product 50 % and nitrogen, phosphorous and potassium fertilizer 50 %), were applied on soil. Responses to treatments were evaluated from height and diameter at breast height at three, six, and nine months after eucalyptus planting. The total phosphorous and potassium content in soil was measured at three and six months after eucalyptus planting. The results showed that the by-product is composed of plagioclase, potassium feldspar, zeolite, smectite, and opaque minerals with apatite as an accessory mineral. The primary oxides found in by-product via X-ray fluorescence were silicon, aluminum, iron, calcium, sodium and with lower concentration, the potassium and phosphorus. In all evaluated parameters, it was verified that T2 and T4 treatments significantly enhanced the available soil phosphorous, and the

eucalyptus height, with maximum gains (79 % and 62 % of phosphorous, and 20 % and 23 % of height) at nine months after eucalyptus plantation. The maximum gains of eucalyptus diameter at breast height were similar (23 % and 24 %) at six months after plantation. Soil available potassium was significantly enhanced in T3, T4 and T2 treatments at nine months after planting, with maximum gains of 71 %, 55 % and 53 %. The work indicated an improvement in the phosphorus and potassium levels in soils, and in eucalyptus crop growth by adding by-product, being a partial nitrogen, phosphorous, and potassium fertilizer substitution strategy. The use of these geological materials is presented as an alternative to increase agricultural productivity and reduce the environmental impacts caused by excessive use of highly soluble fertilizers.

Keywords

By-product of rock mining; Soil remineralizer; Sustainable silvicultura.