

EVALUATION OF EXTRACTANTS FOR CHARACTERIZATION OF K SILICATE AGROMINERALS

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Introduction

In general, Brazilian agricultural soils are poor in macro and micronutrients. Brazil has only one producing potash mine so that more than 90% has to be imported, despite its importance as food producer. This very uncomfortable dependence also has a significant impact on the country's trade balance. Due to actual potash market, it is unlikely that any significant new production capacity will be developed in Brazil from the local potash salt deposits.

Since 2011 TERRATIVA MINERAIS screened locations close to agricultural regions from the Cerrado and with favourable geology and logistics, for syenite rock with up to 14.5% potash content and also high content of other macronutrients. These rocks are uncommon, but Terrativa was able to locate them in key areas by using modern geological tools. TERRATIVA is developing five high grade potash mines (with up to 14.5% K₂O) and is planning the installation of four rock powder plants close to important agricultural zones from the Cerrado.

A 2 year research program from TERRATIVA with the MIT/USA developed Hydrosyenite, a second generation low cost high efficiency potash fertilizer produced from syenite by hydrothermal process, with controlled accelerated release of potash and also other benefits for agriculture. Embrapa is running laboratory and agronomic efficiency tests to evaluate these K silicate agrominerals.

In this way, the objective of this research was to compare procedures of extraction of the bioavailable nutrients in silicate agrominerals.

Methods

The experiment was conducted with 11 silicate agrominerals, which potentials of use have been evaluated by TERRATIVA. Each rock sample were grounded in two granulometry, <2.00mm and

<0.15mm. All the analyses were made in triplicate and in the three methods studied were analysed a known silicate agromineral, the biotite schist (BX).

For the hot water extraction was used the methodology established by the Brazilian Ministry of Agriculture for K fertilizer regulation (MAPA, 2007). In the method the proportion of sample/solution was 1:50. These mixtures were heated until the boiling point (approximately 90 minutes). The solutions were filtered and the K analysed in spectrophotometer.

The Mehlich-1 extractant was originally designed to evaluate the nutrients bioavailable in soil (EMBRAPA, 1997). It is a double acid extractant in low concentration (H₂SO₄ 0,0125 mol L⁻¹ + HCl 0,05 mol L⁻¹). The acid solution is shaken with the sample for 5 minutes in a proportion of 1:10. The solutions were also filtered and the K analysed in spectrophotometer.

The extraction by the citric acid is also a methodology adopted by the Brazilian Ministry of Agriculture, but it is for a P fertilizer regulation (MAPA, 2007). The citric acid solution is prepared in concentration of 2 %. The proportion sample/solution used was 1:100, and these were shaken for 30 minutes. The solutions were also filtered and the K analysed in spectrophotometer.

Results and discussion

All the tested extractants were able to solubilize part of the total K present in the grounded rocks, but the proportion extracted between the methods were different for each rock (Figure 1). Independent of the extractant, in almost all the case, the extraction were higher in the samples with smallest particle sizes (granulometry lower than 0.15mm). These results indicate that the K in grounded rocks in smaller granulometry have more K available to the crops.

The extraction by the hot water was the

lowest compared with the others. It represents the fraction of K which is ready to use, it is the most available portion of K (Figure 1). The intermediate K extraction was observed in the Mehlich-1 method. The citric acid solution was the extractant that presented the highest extraction of K (Figure 1). It indicates the portion of K that is able to be solubilized by exsudates of plant roots in a short time.

The proportion of K extracted by the three methods from the total K were different for each silicate agromineral studied (Table 1). The highest extraction in absolute amount was observed in the sample from the Ceraíma study (PRGB-PCER-MCA-RO0011). However this sample did not have the highest extraction relative terms (Table 1). In general, the samples with the lower total K had higher relative extraction.

Conclusions

The citric acid extraction seems to be the best method to evaluate the K portion available for crop by the silicate agrominerals application in the soil. Rocks with higher potencial for agronomic uses, presenting K available similar or higher than the biotite schist were PRGB-PCER-LCO-RO0048; PRGB-PCER-MCA-RO0011; PRRV-PACR-CAL-RO0015; and PRRV-PACR-CAL-RO0066. The first two samples are from Bahia state (TERRATIVA Ceraíma Project – Silveira Braga *et al.*, 2014), and they are ultrapotassic igneous rocks classified as alkali feldspar syenites. The last two are from Goiás

state (TERRATIVA Acreúna Project – Oliveira *et al.*, 2014) and they are alkaline mafic-ultramafic rocks. The sample PRRV-PACR-CAL-RO0015 is classified as ugandite and PRRV-PACR-CAL-RO0066 is tephriphonolite.

Keywords: Alternative fertilizer; K sources; silicate agrominerals

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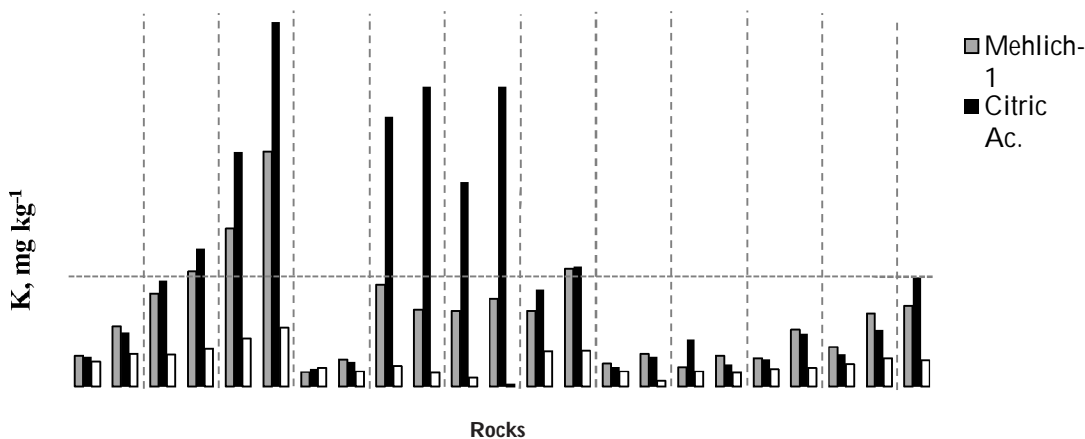


Figure 1. The K concentration extracted by the three methods (Mehlich-1; Citric Acid 2%; and Hot Water)

Table 1. Percentage of the K total of each silicate agromineral extracted by the three methods (Mehlich-1; Citric Acid 2%; and Hot Water)

Silicate Agromineral ID	K			
	Total	Mehlich-1	Citric Acid	Hot Water
	g kg ⁻¹		----- % -----	
PRCO-PBLE-MAF-RO0007 (< 2 mm)	79.3	0.26	0.25	0.21
PRCO-PBLE-MAF-RO0007 (<0,15 mm)	79.3	0.50	0.45	0.28
PRGB-PCER-LCO-RO0048 (< 2 mm)	43.1	1.44	1.64	0.50
PRGB-PCER-LCO-RO0048 (<0,15 mm)	43.1	1.78	2.14	0.59
PRGB-PCER-MCA-RO0011 (< 2 mm)	103.7	1.02	1.51	0.31
PRGB-PCER-MCA-RO0011 (<0,15 mm)	103.7	1.51	2.35	0.38
PRPG-PIPR-PLS-RO0024 (< 2 mm)	42.0	0.23	0.29	0.29
PRPG-PIPR-PLS-RO0024 (<0,15 mm)	42.0	0.43	0.39	0.24
PRRV-PACR-CAL-RO0015 (< 2 mm)	40.2	1.69	4.48	0.34
PRRV-PACR-CAL-RO0015 (<0,15 mm)	40.2	1.28	4.98	0.24
PRGB-PCER-MCA-RO0011 (< 2 mm)	12.2	4.15	11.20	0.51
PRRV-PACR-CAL-RO0017 (<0,15 mm)	12.2	4.81	16.40	0.11
PRRV-PACR-CAL-RO0066 (< 2 mm)	82.7	0.61	0.79	0.29
PRRV-PACR-CAL-RO0066 (<0,15 mm)	82.7	0.95	0.97	0.29
PRRV-PJAT-CAL-RO0007 (< 2 mm)	17.3	0.88	0.77	0.59
PRRV-PJAT-CAL-RO0007 (<0,15 mm)	17.3	1.25	1.15	0.22
PRTD-PSEA-CAL-RO0011 (< 2 mm)	123.6	0.10	0.25	0.08
PRTD-PSEA-CAL-RO0011 (<0,15 mm)	123.6	0.17	0.12	0.08
PRTD-PSEA-DKC-RO102 (< 2 mm)	118.7	0.16	0.15	0.10
PRTD-PSEA-DKC-RO102 (<0,15 mm)	118.7	0.32	0.30	0.10
PRTR-PICO-EBT-RO0013 (< 2 mm)	111.2	0.24	0.19	0.13
PRTR-PICO-EBT-RO0013 (<0,15 mm)	111.2	0.44	0.34	0.17
BX	26.6	2.03	2.73	0.66