# USE OF BLENDS OF SILICATE AGROMINERALS AS A K SOURCE FOR SOYBEAN CROPS

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**Abstract:** This study aimed to test the efficiency of blends of silicate agrominerals as K sources for soybean crops. The experiment was conducted in the surroundings of *Embrapa Cerrados*, Planaltina – DF (TN: city in the Midwest, Brazil), in two field areas with similar climate conditions and different soil types: a medium texture soil and a clay soil. The experiment was carried out in 6 random blocks, with the following treatments: syenite and biotite schist (silicate rocks), and potassium chloride (conventional fertilizer), in doses of 0 kg, 60 kg, 120 kg, 240 kg, and 480 kg of $K_2O$ $ha^{-1}$. The soil was prepared and the treatments on each plot were manually distributed and incorporated into the soil (up to 20 cm). The average yield was low, fluctuating from 500 to 1110 kg $ha^{-1}$, however, all rocks showed higher results than the control treatment. The treatment with KCl showed a higher K absorption compared to the other treatments.

**Keywords**: stonemeal; potassium natural sources; rock dust.

## INTRODUCTION

Potassium (K) is the second most essential nutrient required for soybean crop production. Therefore, potash fertilization is essential in obtaining high yields. The availability of K in the *Cerrado's* soils is very low, insufficient to supply the amount extracted by the crops in successive growing. Therefore, its replacement in the soil must be supplied through fertilization. The K from chemical fertilizers displays high soil solubility, which combined with the low cations-exchange capacity (CEC) of Cerrado's soils, supports the occurrence of leaching losses.

Stonemeal technology, "the use of finely ground rock dust", is an option for supplying this K. Therefore, it is of great importance to demonstrate the efficiency of the use of silicate rocks as an alternative and ecological source of potassium. These rocks correct deficiencies and provide a slow nutrient release for the mineral nutrition of crops, improving the chemical conditions of the soil, which consequently enhances the overall yield (GRECCO et al., 2013; MESSIAS et al., 2013). According to Silva (2012) and Lapido-Loureiro and Figueiredo Neto (2008), the stonemeal can reduce the consumption of industrial fertilizers.

Alternative K sources for food production in tropical soils can contribute to food sovereignty in Brazil, in addition to ensuring healthy food production and a reduction in the use of chemical fertilizers (THEODORO et al., 2013). Moreover, due to small scale fertilizer production unable to meet a larger domestic demand, Brazil imports large amounts of potassium fertilizer (OLIVEIRA, 2014). A major weakness within the nation's agricultural sector is its dependence on fertilizer importation. This dependence reduces yearly yields as well as competitiveness in a global context (BARBOZA, 2011). This work aims to test the efficiency of silicate mineral blends as K sources to soybean crops.

## MATERIAL AND METHODS

The field experiment was carried out concomitantly in two areas of Embrapa Cerrado's surroundings, in Planaltina - DF: one with a medium texture soil (*Serrinha)*, and the other with a clayey soil (*Chapada),* with clay contents of 19% and 85%, respectively. Both areas were new, subsequent to native vegetation, which restricts the possibilities of interferences in the results shown by the treatments.

The experimental design was carried out in randomized blocks, with six blocks for each area. The treatments comprised the blends of Syenite/Ugandite 9.21% of $K_2O$ (TA-33); Syenite/Tephriphonolite 10.9 21% of $K_2O$ (TA-34); Syenite/Biotite 11.3 21% of $K_2O$ (TA-36); and the potassium chloride (KCl) soluble fertilizer performing as the conventional treatment. All treatments included doses of 0 kg, 60 kg, 120 kg, 240 kg, and 480 kg $ha^{-1}$ of $K_2O$ and a control dose of 0 kg $ha^{-1}$ of $K_2O$. The areas were divided into blocks, with one replicate each. The plots were 4 meters in width by 6 meters in length. The treatments were applied manually and homogeneously on the surface along with the plot (Figure 1) and incorporated into 20 cm depth with the aid of a plowing harrow. In the pre-planting soil preparation, throughout the entire plot gypsum amendments and lining were performed to raise the base saturation to 60%. For phosphorus and soil micronutrients correction, phosphate fertilization with triple superphosphate 40% of $P_2O_5$ and FTE – BR – 12 5.7%S + 1.8%B + 0.8%Cu + 2.0%Mn + 0.1%Mo + 9.0%Zn + 0.1%Co was necessary.

**Figure 1 -** Spreading rock dust.

At the time of planting (on December 11, 2014), the BRS 7580 soybean cultivar was used. In the experiment, the soybean cycle lasted 119 days, from the date of planting to harvest. For the shoot sampling (collected on February 10, 2015), two plants per plot were randomly chosen and collected at the beginning of their reproductive stages. The dried vegetation was weighted, milled, and analyzed for silicon contents and macro and micronutrients. This analysis was conducted using the nitro-perchloric digestion method of extraction (SILVA, 1999).

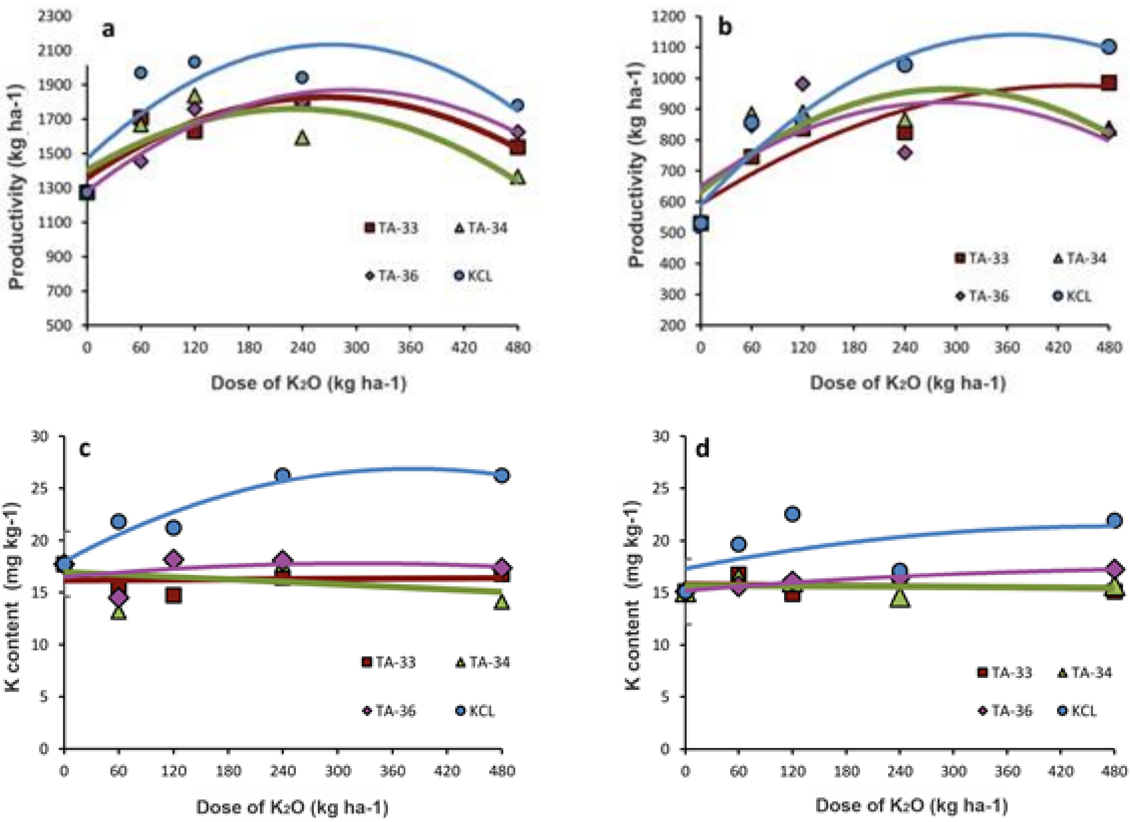
After harvest, soil samples were collected in three different locations per plot. Data collections contained soils from depths: 0-10 cm, 10-20 cm, and 20-40 cm, forming compound samples from each plot. The samples were then sieved through 2 mm mesh and were analyzed for: pH (CaCl2 0,01 mol $l^{-1}$), H+Al (SMP index), exchangeable Aluminum (Titration 1 mol $l^{-1}$); organic matter (Colorimetric – IAC), Phosphorus, Potassium, Calcium, Magnesium (Ion exchange resin), Sulfur (Turbidimetry – Dust BaCl2), Fe, Mn, Cu, Zn (DTPA), and Boron ($BaCl_2.2H_2O$ – micro-waves).

The statistical data analysis was executed using R (a statistical software). All data underwent variance analysis tests and was tested for normality (Shapiro-Wilk) and homogeneity (Bartlett). Mean comparisons were performed using the Tukey test ($P<0.05$), and linear and least square regressions were used to analyze the dosage data.

Blend silicate agrominerals showed to be an inefficient K source for soybean crops, as low average yields varied from 500 to 1110 kg $ha^{-1}$. Despite this, all blends showed higher yields compared to the control treatment. The low yield may be attributed to climate factors (e.g., an extensive drought that occurred at the end of the vegetative stage) and the fact that it was a first-planting area.

The treatments with TA-33 and TA-36, under the agronomic doses of 240 kg $ha^{-1}$ of $K_2O$, show better grain yields than the TA-34 treatment (Figure 2a) in the clayey texture soil, however, in the medium texture soil, under the same doses, the TA-34 displays the highest efficiency, followed by TA-33. The $K_2O$ doses, with the KCl use, showed a yield higher than the other treatments.

**Figure 2 -** Yield (a, b) and K content (c, d) in the shoots of soybean plants according to the application of potassium doses and sources in two areas: clayey texture soil (a, c) and medium texture soil (b, d).



The low agronomic performance of the tested blends can also be attributed to late sowing, which may have caused a reduction in days to flowering (DTF), maturity (DTM), plant height, and grain yield. Likewise, Sékula (2011) observed that in the first year of growth, the alternative fertilizing maintained lower yields than the conventional fertilizing. This is because the agrominerals tend to be gradually soluble, unlike conventional fertilizers (THEODORO, 2000). It is important to highlight that the treatments had higher yields than the yields from the control plots. Figure 2 (c, d) show the results of K accumulation in the soybean shoots during the crop development, in the two crop areas. In general, except for the case of the KCl treatment in the clayey soil area, there was no variation in the K accumulation. The K content in the vegetal tissue for the TA-33, TA-34, and TA-36 treatments indicated a low K availability. The KCl treatment showed higher yields compared to the other treatments. All treatments showed a linear increase in the K accumulation. The K content does not follow the grain yield.

## CONCLUSION

The results obtained indicated the potential of tested blends as a potassium source for soybean crops. The sources' linear behavior indicates the possibility of residual effects as a result of soil treatments.

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