IMMEDIATE AND RESIDUAL EFFECTS OF AN ECOLOGICAL FERTILIZATION MIXTURE ON THE CONCENTRATION OF NUTRIENTS IN BEAN LEAVES

Paulo Eduardo Rocha Eberhardt[1], **Gilberto A Peripolli Bevilaqua**[2], **Josuan Sturbelle Schiavon**[3], **Irajá Ferreira Antunes**[2], **Regis Araujo Pinheiro**[1]
[1]Universidade Federal de Pelotas, pauloeduardorochaeberhardt@gmail.com; regispinheiroagro@gmail.com; [2]Embrapa Clima Temperado, gilberto.bevilaqua@embrapa.br; iraja.antunes@embrapa.br; [3]Cooperfumos, josuanmpa@gmail.com;

INTRODUCTION

Beans are the main source of vegetable protein for the Brazilian population. They are also an important source of iron and zinc, in addition to calcium, magnesium and phosphorus. Common bean production requires balanced nutrition to ensure its production potential and to generate plants with adequate levels of mineral elements. In low-fertility soils, crop nutrition must be supplemented with mineral fertilization (Araujo et al., 1996). Rock powders are characterized by multi-element composition and slow solubilization capacity, which are suitable for use in alternative production systems and in conditions favorable to the leaching of nutrients and in degraded soils (Van Straten, 2006). As the chemical and texture composition of the rocks is quite varied, each one releases its elements at different speeds. Granodiorite is an igneous rock with a chemical composition similar to granite, but containing more plagioclase than alkaline feldspar or orthoclase (Fernandes et al., 2010), and is a good source of potassium. Results obtained by Grecco et al. (2013) with treatments based on granodiorite, presented satisfactory results when compared with the control that used soluble NPK fertilization. The objective was to evaluate the immediate and residual effect of the use of an ecologically based fertilizer mixture on the accumulation of nutrients in bean culture.

MATERIALS AND METHODS

The work was carried out at the Embrapa Clima Temperado, at Terras Baixas Station, located in the city of Capão do Leão, in October 2013. Cv. Iraí, with a determinate habit and early maturity, was used. The soil, a planossol with drainage deficiency, was sieved and placed in pots with a total volume of ten liters of soil. Doses of 0, 500, 1,000, 2,000, 4,000, 8,000 and 16,000 kg.ha^{-1} of the fertilizing compound were used and a control with soluble fertilizer (NPK) was added at a dose of 200 kg.ha^{-1} of fertilizer in the formulation 5-30-15. The rock compound was a mixture of rock powders, with granodiorite and natural phosphate plus tung cake in the same quantities. The rock powder represented a comprehensive composition, regarding K, Ca, P, Mg, N and micronutrients. The trials were evaluated in two seasons, evaluating the immediate effect (sowing in October) and the residual effect (sowing in February). The design used was a factorial between dose of the mixture and time of evaluation, and was completely randomized with three repetitions. In the pre-flowering period, the plants were collected and taken to the greenhouse, at a temperature of 65°C, for drying. After the plants were ground, acid digestion was conducted to evaluate the mineral composition of the plants including the following elements: phosphorus (P), potassium (K), calcium (Ca) and magnesium (Mg) through the method of flame spectrophotometry (Silva, 1999).

RESULTS AND DISCUSSION

Table 1 shows the content of the nutrients evaluated, the interaction between the times of evaluation (immediate and residual) and dose of the mixture. As for Ca, in the evaluation of the immediate effect, the mixture showed a consistent increase in the calcium content of the leaves, that decreased when it was evaluated in the second trial (residual effect). In the second trial, the

mixture overcame the control with soluble NPK. This is due to the slower release of these nutrients in relation to this fertilizer. In the case of Mg, the difference is not so noticeable when comparing between the cultivation right after the application of the agrominerals and the residual effect. For the K content, in the evaluation of the immediate effect, the NPK treatment exceeded the rock fertilizer mixture, however in the second year the rock mixture exceeded the soluble fertilizer. As for the P content, there was an increase in the element content in leaves in the second trial analyzed, however in the first year, there was no increase in P content. This fact was expected due to the effect of solubilization that occurs in the application of reactive natural phosphates whose effect becomes more pronounced in the second year of cultivation.

Table 1. Calcium (Ca), magnesium (Mg), potassium (K) and phosphorus (P) present in pre-flowering bean leaves grown in soil fertilized with a rock powder mixture containing natural phosphate, granodiorite and tung cake evaluating the immediate (first trial) and residual (second trial) to the dose applied to the soil.

Dosis $t.ha^{-1}$	Ca $g.kg^{-1}$		Mg $g.kg^{-1}$		K $g.kg^{-1}$		P $g.kg^{-1}$	
	immediate	residual	immediate	residual	immediate	residual	immediate	residual
0	9,4 b B	20,8ab A	3,79 cd B	4,50 b A	27,89 c A	23,75 a A	1,70 b B	2,97 ab A
0,5	11,7 b B	20,3ab A	3,49 d B	5,16 ab A	26,60 c A	23,26 a A	1,77 b B	2,93 ab A
1	11,4 b B	20,3ab A	4,22 cd B	5,25 ab A	30,12 c A	24,27 a B	1,77 b B	3,17 ab B
2	10,5 b B	22,5a A	4,00 cd B	5,53 a A	29,52 c A	23,32 a B	2,00 b A	2,79 ab A
4	11,8 b B	23,0a A	4,47 c B	5,67 a A	30,20 c A	24,41 a B	2,13 b B	4,02 a A
8	13,3ab B	23,8a A	4,67 bc B	5,36 ab A	31,66 bc A	22,57 a B	1,66 b B	4,08 a A
16	18,6a A	22,3ab A	5,55 ab A	5,26 ab B	36,04 b A	24,65 a B	1,48 b B	3,37 ab A
NPK	15,2ab A	15,8b A	6,14 a A	4,73 ab B	41,87 a A	23,24 a B	3,91 a A	2,49 b B
Media	12,74 B	21,10 A	4,56 B	5,18 A	31,74 A	23,68 B	2,05 B	3,23 A
C.V. (%)	14,4		7,5		7,7		18,4	

*Values follow for the same letter in lines and columns not differ signficantly in the Tuckey test at 5%.

CONCLUSIONS: The use of rock powder mixture based on natural phosphate and granodiorite, and tung cake is an alternative to the chemical fertilization of bean. The dose of 4 t. ha^{-1} shows a good fertilizing effect during two seasons with adequate levels of Ca, Mg, P and K present in the plants.

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