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EFEITO COMBINADO DE MATÉRIA ORGÂNICA E ADUBAÇÃO POTÁSSICA NO DESENVOLVIMENTO INICIAL DO FEIJOEIRO

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RESUMO: Objetivou-se avaliar o efeito combinado da matéria orgânica e da adubação potássica no desenvolvimento inicial do feijoeiro. O ensaio foi conduzido no IFCE/*Campus* Sobral, em vasos. O delineamento experimental foi em blocos casualizados, em esquema fatorial 5 x 2 (cinco doses de potássio x com e sem matéria orgânica), com quatro repetições (blocos). O cloreto de potássio foi testado nas dosagens 100%, 120%, 140%, 160% e 180% da dose recomendada, parcelada em duas aplicações semanais, durante três semanas. Para fator matéria orgânica, utilizou-se o esterco bovino em dose única, onde um nível deste fator foi representado somente por solo arenoso e, o outro nível solo arenoso mais esterco (1/1). Trinta dias após o plantio, avaliou-se a altura da planta, o número de folhas, o comprimento da raiz, o diâmetro do caule, a massa fresca da parte aérea, a massa seca da parte aérea, a massa fresca da raiz e a massa seca da raiz. Os resultados mostraram que a adubação potássica apresentou efeito significativo apenas para a variável número de folhas, reduzindo sua quantidade na planta. A adubação com esterco bovino respondeu significativamente para todas as variáveis avaliadas. Assim, conclui-se que o uso da matéria orgânica favorece o desenvolvimento de plantas de feijoeiro na fase inicial de desenvolvimento.

Palavras-chave: *Vigna unguiculata*, potássio, esterco bovino.

COMBINED EFFECT OF ORGANIC MATTER AND POTASSIUM FERTILIZATION ON THE INITIAL DEVELOPMENT OF BEANS

ABSTRACT: The objective was to evaluate the combined effect of organic matter and potassium fertilization on the initial development of the bean plant. The trial was conducted at IFCE/Campus Sobral, in pots. The experimental design was in randomized blocks, in a 5 x 2 factorial scheme (five doses of potassium x with and without organic matter), with four replications (blocks). Potassium chloride was tested at dosages of 100%, 120%, 140%, 160% and 180% of the recommended dose, divided into two weekly applications, for three weeks. For the organic matter factor, cattle manure was used in a single dose, where one level of this factor was represented only by sandy soil and the other level by sandy soil plus manure (1/1). Thirty days after planting, plant height, number of leaves,

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root length, stem diameter, aerial part fresh mass, aerial part dry mass, root fresh mass and root dry mass were evaluated. The results showed that potassium fertilization had a significant effect only on the variable number of leaves, reducing their quantity on the plant. Fertilization with cattle manure responded significantly to all variables evaluated. Thus, it is concluded that the use of organic matter favors the development of bean plants in the initial phase of development.

Keywords: *Vigna unguiculata*, potassium, cattle manure.

1 INTRODUCTION

The common bean is a plant that requires many nutrients, and because it has a short cycle, these nutrients must be available, thus preventing productivity from being limited. Among the macronutrients required by common bean, potassium stands out. Common bean requires relatively high amounts of potassium, second only to nitrogen. Almost the total amount of potassium is absorbed by common bean between 40 and 50 days after emergence (Buzetti; Andreotti; Teixeira Filho, 2015). Sguario-Junior et al. (2006) reported that bean plants can extract, on average, 93 kg t^{-1} K_2O from the soil and export 15.4 kg t^{-1} K_2O through the seeds at harvest time.

A review of 232 trials conducted in eight states revealed that bean plants responded to potassium fertilization in one trial in Pará, one trial in the Federal District, eleven in São Paulo and two in Rio Grande do Sul, resulting in a total of 6.5% of cases with a positive response to potassium (Malavolta; Haag, 1972).

OM is an important component in maintaining fertility, since clay minerals with low cation exchange power predominate in Brazilian soils. In soils where the tropical climate predominates, the mineralization of organic matter is quite rapid and is accelerated even further by the correction of its chemical properties and disturbance caused by crops. Intensive cultivation using high doses of mineral fertilizers temporarily increases productive capacity but can also lead to degradation in the medium or long term if the mineralized organic matter is not replaced (Kiehl, 1985).

To analyze the initial development of bean crops and, consequently, increase their productivity, the aim of this study was to evaluate the combined effects of organic matter and potassium fertilization on bean crops. Given the above, investigations into different dosages of potassium fertilizer and organic matter and their influence on the initial growth of bean plants are necessary.

2 MATERIALS AND METHODS

The research was carried out from September to October 2023 in the area of the IFCE/*Campus* Sobral. The bean seeds were sown in 1 L pots. The pots were filled with sandy textured soil, and 1 cm of washed gravel was placed to prevent soil loss through the holes in the jars and facilitate the drainage of irrigation water.

The trial was conducted in a randomized block experimental design with a 5 × 2 factorial scheme (five potassium doses with and without organic matter), with four blocks. The potassium source used was potassium chloride at the following doses: 100%, 120%, 140%, 160% and 180% of the recommended dose for bean crops, which was divided into two weekly applications for three weeks. For the organic matter factor, mineralized cattle manure was used for one of the levels (soil + organic matter, applied in a single dose). The other level consisted only of soil.

Thirty days after planting, the plant height (H - cm), number of leaves (NF), root length (CR - cm), stem diameter (DC - cm), fresh aerial part mass (MFPA - g), dry aerial part mass (MSPA - g), fresh root mass (MFR - g) and dry root mass (MSR - g) were evaluated.

For the height of the plant, which was measured with a ruler, the length between the plant's neck and the insertion of the flag leaf was considered. The stem diameter was measured 0.5 cm from the soil with the help of a digital caliper. The weight was obtained via a precision analytical electronic balance. To

determine the dry matter, the plants were placed in paper bags, left to dry in a forced circulation oven at a temperature of 70 ± 1 °C, and weighed using a precision analytical balance of 0.0001 g.

The data were subjected to analysis of variance via the F test, and when significant, the means were subjected to the Tukey test at a significance level of 5% for the organic matter (OM) factor. When the potassium chloride dose (KCl dose) was significant, regression analysis was used. All analyses were performed via R: A Language *software.* and Environment for Statistical Computing, R version 4.3.2 (R Core Team, 2023), with the AgroR package Experimental Statistics and Graphics for Agricultural Sciences, version 1.3.5 (Shimizu; Marubayashi; Goncalves, 2023).

3 RESULTS AND DISCUSSION

For the organic matter factor, a significant effect was observed for the variables plant height, stem diameter, number of leaves, and fresh and dry mass of the aerial parts and roots. For the potassium fertilization factor, a significant effect was observed only for the variable number of leaves. No interaction was observed between the factors (Table 1).

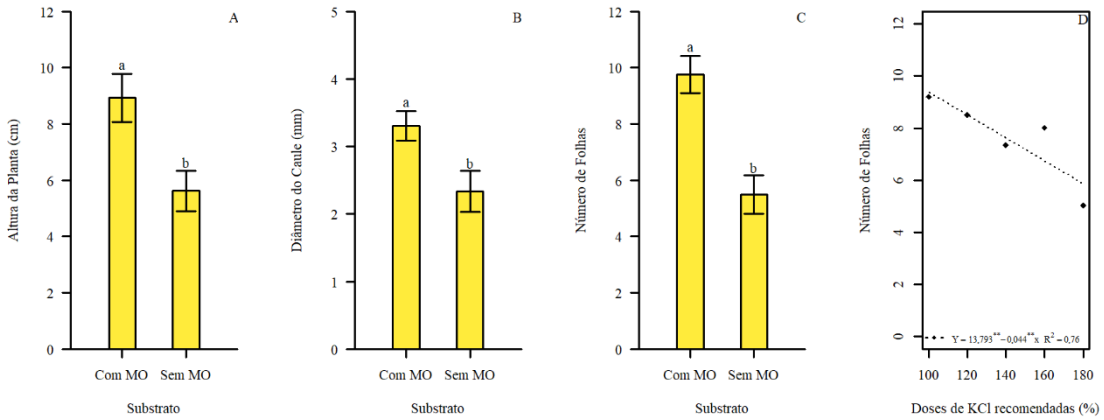
Table 1. Summary of analysis of variance for the variables plant height (AP), number of leaves (NF), stem diameter (DC), fresh mass of aerial part (MFPA), fresh mass of root (MFR), dry mass of aerial part (MSPA), dry mass of root (MSR) of beans, degrees of freedom (GL), organic matter (OM), doses of potassium chloride (KCl) and coefficient of variation (CV).

Sources Variation	**GL**	**Mean Square**						
		AP	**A.D**	**NF**	**MFR**	**MFPA**	**MSR**	**MSPA**
MO	1	109.45**	9.36*	182.04**	79.88**	84.25**	4,761**	0.848**
KCl	4	15.18 ^{ns}	2.10 ^{ns}	20.35*	1.43 ^{ns}	6.02 ^{ns}	0.034 ^{ns}	0.112 ^{ns}
Block	3	75.59**	0.52 ^{ns}	10.13 ^{ns}	2.58 ^{ns}	8.08*	0.125 ^{ns}	0.185*
MOxKCl	4	7.72 ^{ns}	0.50 ^{ns}	6.93 ^{ns}	2.69 ^{ns}	5.96 ^{ns}	0.034 ^{ns}	0.112 ^{ns}
Error	27	6.01	1.52	7.42	1.44	2.7	0.061	0.054
CV (%)		33.71	43.78	35.74	47.77	37.14	48.76	36.56

Source: prepared by the authors.
Note: *F value significant at the 5% level; **F value significant at the 1% level; ^{ns} F value not significant (P >0.05).

The plants that received cattle manure were taller (Figure 1A), had greater stem diameters (Figure 1B) and had greater numbers of leaves (Figure 1C). The results obtained in this research corroborate those of Araújo; Silva; Menezes (2011), who reported that manure is a widely adopted solution for the supply of nutrients, such as nitrogen (N), phosphorus (P) and potassium (K), in the soils of semiarid regions. Oliveira; Bruno; Araújo; Silva; Gonçalves; Costa, (2000) reported that the use of cattle, goats, chicken manure and earthworm humus in fertilization provided, from the point of view of yield, bean seed production above the national average, indicating the benefits of its use in production. Galbiatti; Silva; Franco; Caramelo (2011) reported that the best bean productivity was obtained in treatments that received biodigester effluent from cattle manure.

Figure 1. Effects of organic matter on the height (A), stem diameter (B) and number of leaves (C) and the effect of potassium fertilization on the number of leaves (D) of bean plants in their initial development phase. Treatment means followed by the same letter indicate that there is a difference between them according to the Tukey test at the 5% significance level.

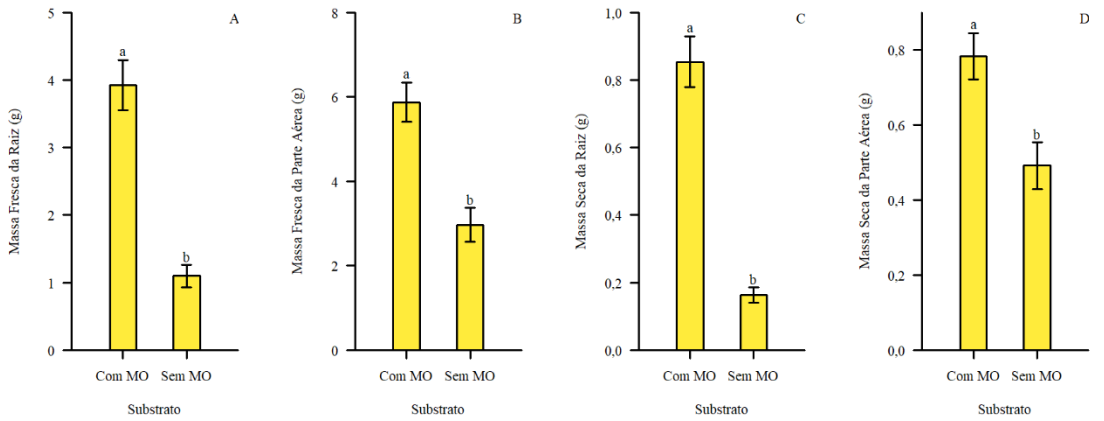


Source: prepared by the authors.

For the potassium chloride doses, there was a reduction of 0.044 units in the number of leaves per unit of percentage of the recommended fertilization (Figure 1D). The value considered critical for the normal development of beans is low, between 20 and 40 kg ha $^{-1}$, but enough to cause high concentrations of this nutrient in the plant tissue (Mello; Sobrinho; Arzolla; Silveira; Netto; Kiehl, 2005). On the basis of this statement, it is believed that the potassium levels tested were sufficient; however, the reduction in the number of leaves, as increasing doses above the recommended level were used, could have been caused by toxicity in the plants fertilized with nutrients above the recommended level.

The plants that received cattle manure presented greater fresh and dry masses of roots and shoots (Figure 2). Studies with cowpea production obtained similar results (Fonseca; Brito; Bebé; De Magalhães Arantes; Dos Santos, 2016). These authors reported that the dry matter of the shoots and total dry matter differed with the application of manure to bean plants subjected to irrigation water salinity, thus indicating a dependence on these factors.

Figure 2. Effects of organic matter on the fresh root mass (A), fresh shoot mass (B), dry root mass (C) and dry shoot mass (D) of common bean plants in their initial development phase. Treatment means followed by the same letter indicate that there is a difference between them according to the Tukey test at the 5% significance level.



Source: prepared by the authors.

According to Machado; Da Silva Gomes; Turatti; Pauletto; Junior (1983), in trials related to the yield of cowpeas cultivated with cattle manure, during the growth and development of the plants, the doses of cattle manure, together with the mineral nutrients added to the soil, likely supplied the nutritional needs of the crop in a balanced way. The adequate application of high-quality manure can meet the needs of plants for macronutrients due to the increase in the levels of available P and K.

4 CONCLUSIONS

The use of organic matter favors the initial development of bean plants.

Potassium fertilization should be applied according to the recommended dosage for bean cultivation.

Potassium fertilization, with doses above the recommended level, reduces the number of leaves on bean plants in their initial phase of development.

The use of fertilization with potassium chloride combined with organic fertilization when growing beans is recommended.

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