RESPONSE OF SIX COMMON BEANS CULTIVARS TO PHOSPHATE AND POTASSIUM FERTILZATION IN LICHINGA, NIASSA, MOZAMBIQUE

RESPOSTA DE SEIS CULTIVARES DE FEIJÃO VULGAR A ADUBAÇÃO COM FÓSFORO E POTÁSSIO EM LICHINGA, NIASSA, MOÇAMBIQUE

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Resumo

Conduziu-se estudo de campo objetivando verificar a resposta da cultivar de feijão comum BRS 293 Pontal à adubação básica com Fósforo (P) e Potássio (K), nas condições edafoclimáticas de Lichinga, Niassa, Moçambique. Usou-se um desenho experimental fatorial completo 5x4, sendo cinco doses de P_2O_5 (0, 35, 70, 140, e 280 kg/ha, como Superfosfato Triplo) e quatro doses de K_2O (0, 50, 100 e 200 kg/ha, como Cloreto de Potássio). A área experimental foi adubada também com 90 kg/ha de Nitrogênio (N), na forma de Uréia, dividido em aplicação de 23 kg N/ha no plantio e 67 kg N/ha 20 dias após a emergência das plantas. Cada tratamento foi replicado quatro vezes no campo, em blocos ao acaso (18 m^2 cada, contendo cinco linhas de seis metros lineares cada, espaçadas entre si 0,45 m, com nove sementes plantadas por metro linear). Na colheita (área útil de 3 m das três linhas centrais), avaliou-se o estande final de plantas, grau de acamamento, número de vagens por planta, número de grãos por vagem, peso de 100 grãos e a produtividade. Com base na análise dos dados obtidos, conclui-se que a máxima produtividade, equivalente a 3.616 kg de grãos/ha, seria obtida com a combinação de 406 kg/ha P_2O_5 e 43 kg/ha K_2O. Esta dose de esta acima do esperado, o que indica que serão necessários novos estudos para melhor recomendação de adubação com P nesta área.

Palavras-chave: Adaptação de plantas. Desenvolvimento de sistemas de produção. Projeto Pro Savana. Recomendação de adubação.

Abstract

A field experiment was conducted to check out the response of the common bean BRS 293 Pontal to basic fertilization with Phosphorus (P) and Potassium, in the environmental conditions of Lichinga, Niassa, Mozambique. A complete factorial 5x4 was used, with five rates of P_2O_5 (0, 35, 70, 140, and 280 kg/ha, as Triple Superphosphate) and four rates of K_2O (0, 50, 100 and 200 kg/ha, as Potassium Chloride). The experimental area was also fertilized with 90 kg/ha of Nitrogen (N), as Urea, spliced in 23 kg N/ha at planting and 67 kg N/ha 20 days after plants emergency. Each treatment was replicated four time in the field, in randomized blocks (18 m2 each, with five liner of six lineal meters each, spaced 0,45 cm, with nine seeds seeded per meter). At harvest (area of 3 m within the central lines), it was evaluated the plant final stand, degree of lodging, number of pods per plant, number of grains per pod, weight of 100 grains, and productivity. Based in the analysis of the data, it is concluded that maximum productivity, equivalent to 3,616 kg of grains/ha, would be obtained with a combination of 406 kg/ha of P_2O_5 and 43 kg/ha of K_2O. Such rate is above what would be expected, which indicates that new studies would be necessary for better recommendation of P_2O_5 fertilization in this area.

Key words: Plant adaptation. Development of production systems. Pro Savanna Project; Fertilizer recommendation.

Introduction

The low availability of nutrients in soils of tropical areas, especially phosphorus (P), is one the most important factors limiting plants productivity. Common beans (*Phaseolus vulgaris* L.), one of the most important leguminous plant for human consumption because of its high nutritive value and protein content (Shinano et al., 1993; Fageria, 2002), require modest quantities of P for production. It needs about 4 kg of P to produce 1000 kg of grains (Fageria et al., 2007). However, as soil P availability is affected by several chemical reactions, substantial quantities of P fertilizers have to be added to assure enhanced productivity.

Potassium (K) is also an important nutrient to increase common beans productivity, being taken up by plants second only to Nitrogen (N). It is needed about 27 kg of K to produce 1000 kg of grains (Fageria et al., 2007). Fortunately, soils commonly present higher amounts of K than P. On the other hand, given is positive charge, is easily leachable from the soil by rainy water, especially in sandy soils or those with high content of clay type 1:1. Thus, it is important to keep its availability to attend plant demands by proper fertilization, based on soil analysis recommendations.

In this paper we report a study conducted to evaluate the response of different common beans varieties to P and K fertilization in the environmental conditions of Lichinga, Niassa, Mozambique. The objective of the work was to produce information that could be used for

recommendation of proper fertilization aimed to increase productivity of common beans in the area.

Material and Methods

The experiment was carried out in the Zonal Center of Investigation North-West, in Lichinga, Niassa, Mozambique. Soil in the experimental area is a clayish one, whose main characteristics are presented in Table 1.

Experimental design was a factorial 5x4, encompassing five levels of P_2O_5 (0, 35, 70, 140, and 280 kg/ha); and four levels of K_2O (0, 50, 100 and 200 kg/ha). The source of P_2O_5 was Triple Superphosphate, and of K_2O was Potassium Chloride. The whole area received a 90 kg/ha basic fertilization with N, as urea, divided in two applications. The first was at planting, equivalent to 23 kg N/ha; and the second was as cover fertilization, with the equivalent to 67 kg N/ha, applied 20 days after plant emergence. Every treatment was replicated four times in plots in the field, distributed in a complete randomized block design. Each plot measured 18 square meters, encompassing five rows of six meters each, and spaced among them by 0.45 meters.

The Brazilian common beans cultivar BRS 293 Pontal was used for this study. It was planted in 15/12/2012, using nine seeds per lineal meter. It was considered as harvestable plots an area of three lineal meters within the three central planting lines, for production and other variables determination procedures. The evaluated parameters were final plant stand, percent of plant lodging, number of pods per plant, number of grains per pod, mass of 100 grains, and grain productivity. All data were statistically compared through variance analysis ($P<0.05$) and surface response.

Results and discussion

The Brazilian common beans cultivar BRS 293 Pontal began to flower at 04/02/2013, and was harvested in 27/03/2013. Results obtained indicated that there was a positive effect of the P and K fertilization (Table 1), with evidences that the effect of P was more pronounced than that of K. It seems that the salinity caused by using Potassium Chloride as K source affected plants development, as plant stand decreased in parallel with the increasing rates of K_2O.

Even though, there was a positive interaction between P_2O_5 and K_2O fertilization (Table 1 and Figure 1). The maximum productivity estimated using the surface of response analysis (Figure 1) was 3,616 kg/ha of grains per hectare, which would be achieved with a combination of 406 kg/ha P_2O_5 and 43 kg/ha K_2O.

Such high rate of P_2O_5 is above what would be expected, if considered soil P availability in the area. It would also unlikely be recommendable as maintenance fertilization, as a best economic rate should be pursued. It is possible that these high rate requirements were obtained as a result of the way the fertilizers were applied, by spreading at planting. It is advisable that the experiment to be further replicated in the field and the fertilizer be incorporated at planting, with

its deposition close to the plants roots. This would certainly render better plant performance and higher efficiency on P_2O_5 usage by common beans in the area.

Conclusions

The fertilization of common beans with P and K resulted in a good average productivity, despite high natural availability of these nutrients in the soil.
It is advisable to reply the study, with the incorporation of P_2O_5 fertilizer at planting.

References

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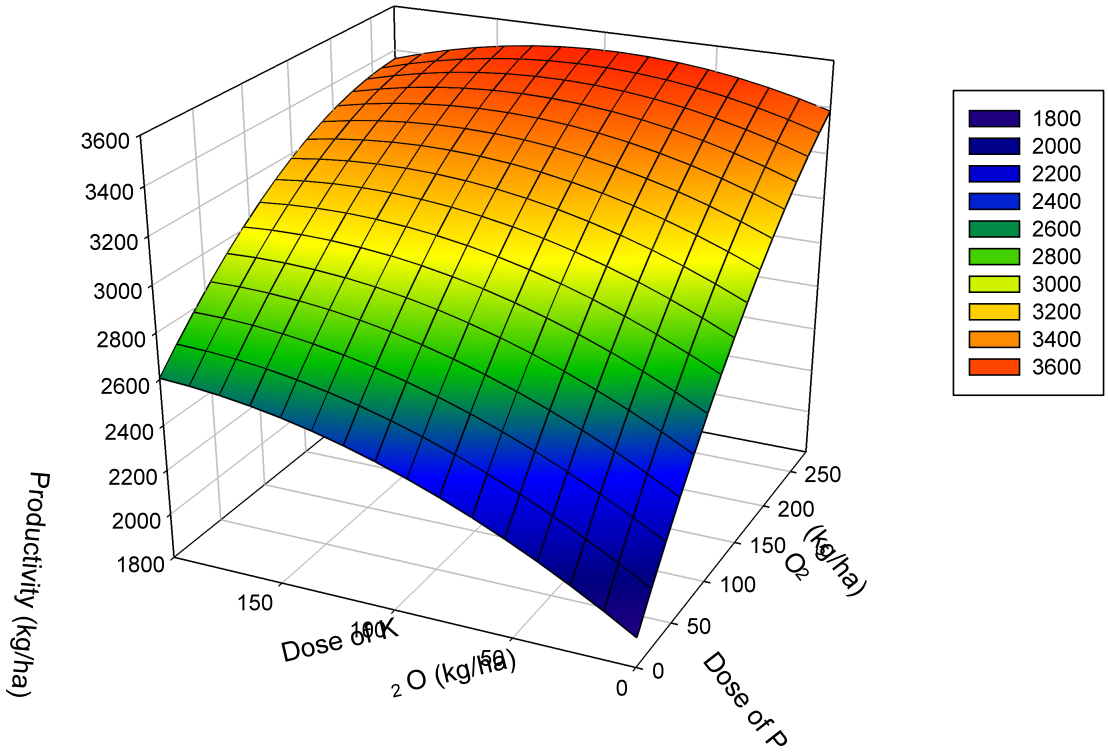

Figure 1. Productivity (kg/ha) of the common bean cultivar BRS 293 Pontal in response to P and K fertilization in Lichinga, Niassa, Mozambique. Productivity = 1,930 + 7.628P + 6.34K - $0.0087P^2$ – 0.0125PK – $0.0148K^2$, $R^2 = 0.43^{(p<0.001)}$

Table 1. Main characteristics of the soil within the experimental area in Lichinga, Niassa, Mozambique.

Organic matter	Clay	pH	P(Mehl)	K	Ca	Mg	Al	H+Al	CTC	SB	V
-------- % -------		Water	----- mg/dm^3 -----		---------- $cmol_c/dm^3$ ----------						%
2.4	44.0	6.1	23.7	116.0	1.1	0.5	6.5	74.3	73.8	19.0	25.7

Table 2. Effects of the P and K increasing rates on final plant stand (PFS), grade of lodging (GL), number of pods per plant (NPP), number of grains per pod (NGP), weight of 100 grains (P100), and average productivity (PROD) of common bean variety BRS 293 Pontal in Lichinga, Niassa, Mozambique.

P_2O_5 or K_2O rates Kg/ha	PFS pl/m	GL 1 to 9	NPP	NGP	P100 g	PROD kg/ha
			P_2O_5 rates			
0	7.1	3.3	17.9	6.4	26.9	2357
35	7.9	2.6	15.4	6.5	27.5	2528
70	7.1	2.6	15.9	6.3	27.6	2500
140	7.8	2.8	16.8	6.5	27.1	3183
280	7.2	2.7	17.3	6.3	27.1	3414
Mean	7.4	2.8	16.7	6.4	27.3	2796
			K_2O rates			
0	8.2	2.4	17.6	6.7	26.7	2659
35	7	3.2	15.7	6.3	27.3	2473
70	7.7	3	16.2	6.3	27.7	3124
140	6.8	2.6	17.2	6.4	27.5	2929
Mean	7.4	2.8	16.7	6.4	27.3	2796
			Probability of F test			
Rates of P	1	0.93	1.2	0.9	1	18.9***
Rates of K	2.9*	1.71	1.1	2.6*	0.6	8.9***
P x K	0.8	1.79	1.2	0.6	1.1	2.6**
CV (%)	21.8	44.6	21.9	8.2	9.6	15.5

Numbers followed by *, or **, or ***, are statistically significant ($P<0.05$, $P<0.01$ or $P<0.001$), respectively.